

HP 1000 Computer Systems

 HEWLETT
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A-Series Hardware Technical Data



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Documentation Summary of HP 1000 Data Books

| | | |
|-------------------------|--|--|
| I/O ARCHITECTURE | Distributed Intelligence | Centralized Intelligence |
| COMPUTER SERIES | A | E/F |
| SYSTEMS AND COMPUTERS | HP 1000 A-Series Hardware Technical Data | HP 1000 E/F-Series Hardware Technical Data |
| INTERFACES | HP 1000 A-Series Interfaces Technical Data | HP 1000 E/F-Series Interfaces Technical Data |
| SOFTWARE | HP 1000 Software Technical Data, Volumes I and II | |
| COMMUNICATIONS | HP 1000 Computer Systems Communications Products Technical Data book | |
| PERIPHERALS | HP 1000 Peripherals Selection Guide | |
| MEASUREMENT AND CONTROL | Control/1000 Technical Information Package | |
| | HP 2250 Measurement and Control Systems Technical Data | |

NOTE: Data book supplements containing new or revised information may be printed between data book revisions. Ask your Hewlett-Packard representative for the current data book or supplement in your area of interest.

Product Number Index

| Product No. & Name | Page |
|---|------|
| 12030A 10-Slot Card Cage | 33 |
| 12032A 5-Slot Card Cage | 33 |
| 12153A Writable Control Store for A700 | 37 |
| 12155A PROM Control Store for A700 | 37 |
| 12205A A900 Control Store Board | 39 |
| 2106BK A600+ Board Computer | 33 |
| 2137A A700 Computer | 27 |
| 2139A A900 Computer | 27 |
| 2156B A600+ Computer | 27 |
| 2196C/D Model 26 System Processor Unit | 13 |
| 21976C/D Model 27 System Processor Unit | 13 |
| 2199C/D Model 29 System Processor Unit | 13 |
| 2436A/E Micro 26 System Component | 19 |
| 2437A Micro 27 System Component | 19 |
| 2439A Micro 29 System Component | 19 |
| 2486A Micro 26 System Processor Unit | 19 |
| 2487A Micro 27 System Processor Unit | 19 |
| 2489A Micro 29 System Processor Unit | 19 |

Alphabetical Index

| Product Name/Topic | Page |
|--|------|
| A600+ Board Computer | 33 |
| A600+ Computer | 27 |
| A700 Computer | 27 |
| A700 Control Store Cards | 37 |
| A900 Computer | 27 |
| A900 Control Store Board | 39 |
| AC Power Requirements | 41 |
| A-Series Capability and Performance-Packaging Summary | ii |
| A-Series Computer Design and Specifications | 1 |
| Computer Power Supply and Card Cage Slot Availability (+) and Requirements (-) | 42 |
| Environmental Specifications | 45 |
| Instruction Repertoire and Execution Times | 9 |
| Micro 26 Computer Systems | 19 |
| Micro 27 Computer Systems | 19 |
| Micro 29 Computer Systems | 19 |
| Model 26 Computer Systems | 13 |
| Model 27 Computer Systems | 13 |
| Model 29 Computer Systems | 13 |
| Physical Characteristics | 44 |

Information Locator

| | |
|--|----|
| HP 1000 A-Series Computer Design and Specifications | 1 |
| Model 26, 27, and 29 Computer Systems | 13 |
| Micro 26, Micro 27, and Micro 29 Computer Systems | 19 |
| A600+, A700, and A900 Computers | 27 |
| A600+, Board Computer | 33 |
| A700 Control Store Cards | 37 |
| A900 Control Store Board | 39 |
| Power Requirements | 41 |
| Computer Power Supply and Card Cage Slot Availability (+) and Requirements (-) | 42 |
| Physical Characteristics | 44 |
| Environmental Specifications | 45 |



Table 1. HP 1000 A-Series Compability-Performance-Packaging Summary

| CAPABILITY-PERFORMANCE COMPARISON | A900 COMPUTER | A700 COMPUTER | A600+ COMPUTER |
|---|---|---|-----------------------------|
| SPEED OF FASTEST INSTRUCTION | 3,000,000 instr/sec | 1,000,000 instr/sec | 1,000,000 instr/sec |
| FLOATING POINT OPERATIONS/SEC | Hardware FPP is standard | Hardware FPP is optional | FP is firmware-based |
| -- Single-precision F/W-based | Not applicable | 54,400 | 64,000 |
| -- Single-precision H/W-based | 500,000 | 204,000 w/12156A | Not applicable |
| -- Double-precision H/W-based | 245,000 | 99,700 w/12156A | Not applicable |
| SCIENTIFIC INSTRUCTION SET | Standard | With 12156A FPP | Software equiv. routines |
| -- Single-precision oper/sec | 50,000 | 36,000 | Not specified |
| VECTOR INSTRUCTION SET | Standard | With 12156A FPP | Software equiv. routines |
| -- Single-precision speed | 688,000 oper/sec after 4.9 microsecond setup | 245,000 oper/sec after 13.5 microsecond setup | Not specified |
| -- Double-precision speed | 421,000 oper/sec after 6.2 microsecond setup | 144,000 oper/sec after 13.5 microsecond setup | Not specified |
| MAIN MEMORY CAPACITY/CARD CAGE SLOTS USED BY CPU AND MEMORY | | | |
| -- ECC (256K RAMs) | 3 Mb to 21 Mb*/5 to 12* | 1 Mb to 8 Mb/4 to 8 | 512 kb to 8 Mb/2 to 6 |
| -- ECC (64K RAMs) | 768 kb to 6 Mb*/5 to 13* | 512 kb to 2 Mb/4 to 8 | Not available |
| -- Parity (64K RAMs) | Not available | 512 kb to 4 Mb/4 to 8 | 512 kb to 4 Mb/2 to 6 |
| MEMORY CYCLE TIME | 181 nanosec average effective, assuming 88% cache hit rate | 500 nanosec | 454 nanosec |
| I/O BANDWIDTH | | | |
| -- Output | 2.5M bytes/second | 4.0M bytes/second | 4.27M bytes/second |
| -- Input | 3.7M bytes/second | 4.0M bytes/second | 4.27M bytes/second |
| AVAILABLE I/O SLOTS* | | | |
| -- In 20-slot box computer | 15 | 16 without 12156A FPP, 15 with 12156A FPP | 18 |
| USER MICROPROGRAMMABILITY | Yes, with 4k words of WCS and 2k words of PROM control store available to the user. | Yes, with half (8k words) of control store available to the user. | No |
| PACKAGING | | | |
| -- Systems (page 13) | Model 29 (2199C/D) | Model 27 (2197C/D) | Model 26 (2196C/D) |
| -- Micro/1000 Systems (page 19) | Micro 29 (2489A or 2439A) | Micro 27 (2487A or 2437A) | Micro 26 (2486A or 2436A/E) |
| -- Computers (page 27) | 2139A | 2137A | 2156B |
| -- Board Computer (page 31) | Not available | Not available | 2106BK |

* A maximum of four memory array cards (half the maximum capacity shown here) is supportable with battery backup.

All I/O Slots have direct access to memory.

HP 1000 A-Series Computer Design and Specifications

HP 1000 A-Series Computer Systems

The HP 1000 A-Series comprises a compatible family of computers that feature distributed intelligence input/output. This design uses an I/O processor on each interface to maximize I/O efficiency and minimize CPU involvement with I/O operations, thereby optimizing overall processor price/performance for a wide variety of applications.

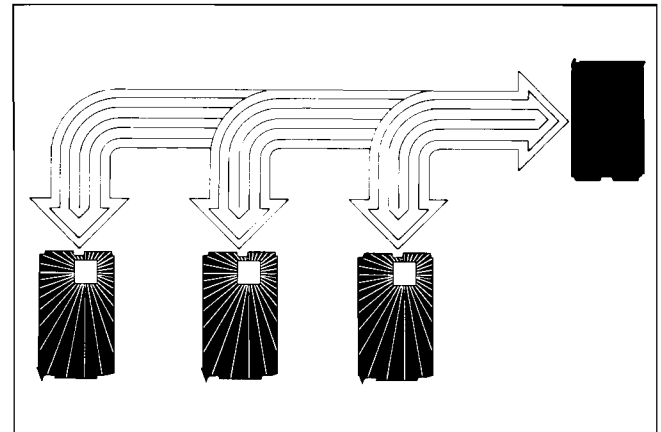
Features

- Total compatibility of comparable instructions in all A-Series computers
- A wide choice of computer performance levels from 1 to 3 million instructions/sec and 64k to 500k floating point operations/sec
- Distributed intelligence I/O design for DMA per channel efficiency
- High reliability and maintainability through the use of simple packaging, self test, and board level diagnostics
- Built-in dynamic mapping system, memory protect, and time base generator
- ECC memory capacity up to 21 Mb in A900, up to 8 Mb in A600+ and A700
- Support for Virtual Memory for data to 128M bytes and up to 15 Extended Memory Areas for data up to 2M bytes, each accessible to as many as 63 different programs
- Extensive software support including operating system, FORTRAN and Pascal compilers, BASIC interpreter and compiler, Macroassembler, screen editor, data base management system, graphics software, distributed systems networking, and manufacturing applications
- Boot loaders included for boot-up from:
 - Adjacent computer system in a DS/1000-IV Distributed Systems Network
 - Disc drive
 - Magnetic tape
 - PROM Storage Module
- Remote loading and diagnosis for programming and operation of systems from remote sites

Overview (See Table 1, facing.)

The A900 Computer

The A900 is Hewlett-Packard's fastest HP 1000 Computer. Pipeline technology with cache memory, boosted even more by a fast hardware floating point processor with



scientific and vector instruction sets, provides unmatched computation speed. Base set speed of 3 million instructions per second and 500,000 floating point operations per second provide enough computational power to conquer thousands of applications that have previously been far beyond the reach of minicomputers. A sizable 768k bytes of Error Correcting Code (ECC) memory is standard and battery backup is optional to maximize system integrity. The base 768k bytes can be replaced with 3M bytes, which is expandable to a total of 21M bytes, providing enough capacity for very large applications. User micro-programming is supported, permitting the development of special instructions or the conversion to firmware of frequently-used software routines for significantly-faster execution.

The A700 Computer

The A700 is a microprogrammed and user-microprogrammable computer that offers the user exceptional flexibility. For applications that require higher speed calculations than are possible with firmware and software in the base A700 computer, an optional hardware floating point processor with scientific and vector instruction sets provides 6 to 12 times faster floating point math, up to 31 times faster trigonometric and transcendental calculations, and 8 to 20 times faster vector and matrix arithmetic.

The A600+ Computer

The A600+ is a full-function microcomputer that offers the HP 1000 user 1 million instructions per second performance at surprisingly low cost. Although the A600+ is a microprogrammed computer, it is not designed to support microprogramming by the user.

Packaging

Systems. The A600+, A700, and A900 Computers are available in free-standing Model 26, 27, and 29 Systems configured around a set of basic system elements, called the System Processor Unit (SPU). These systems are managed by the RTE-A Real-Time Executive Operating System, which supports multi-programming, high-level program languages, virtual memory and sharable extended memory areas for data, data base management, distributed systems networking, graphics software, and up to 21 megabytes of main memory in the Model 29, up to 8 megabytes in the Model 26 or 27.

All of these systems support the VC+ enhancement to RTE-A for execution of programs up to 7.75 megabytes. The VC+ software is included in the Model 27 and 29 systems.

The SPU hardware consists of the A-Series Computer as described below, HP-IB disc interface and serial (system console) interface, with 13 to 16 card cage slots available for additional memory and I/O cards. This is housed in either a tall cabinet with extra rack space for additional equipment or a short cabinet without extra space.

To the SPU, OEMs and end users add an operator terminal, one or more hard discs, and other peripheral devices as needed for their applications. Multiple fixed discs with 24 to 404 megabyte capacity, some with built-in tape cartridge backup, can be used on the system. Up to 1.6 gigabytes of disc capacity can be connected via a single disc interface.

Micro/1000 systems. For applications that require A600+, A700, or A900 performance in a small space, the Model 26, 27, and 29 systems are available in a Micro/1000 package as the Micro 26, Micro 27, and Micro 29 systems. These systems, which have a 12-slot card cage (vs 20 slots in the larger systems) can include integral 14.5M byte fixed and 270k byte microflop discs or any of the discs available with the Model 26, 27, and 29 systems. The Micro/1000 systems support 92078A VC+ for programs to 7.75 megabytes.

Computers. The A600+, A700, and A900 computers are available in packaged form as the 2156B, 2137A, and 2139A (box) Computers for users who desire to package their own hardware and software. These box computers include a 20-slot card cage, of which 15 to 18 card cage slots are available after provision for computer and memory circuit boards of the base configuration.

Board Computer. The A600+ computer is available as the 2106BK board set for packaging into OEM products.

Memory system

The memory system for A-Series computers is a mapped array differing among the computers with respect to size and type of memory supported, as summarized in Table 1. Memory access is managed by the dynamic mapping system, a powerful combination of hardware and special instructions built into the computer, a capability that gives A-Series users efficient use of large memory systems with minimal programming effort.

The choice of memory array cards available for A-Series computers includes ECC memory cards based on 256K RAMs for all A-Series computers, ECC memory cards based on 64K RAMs for A700 and A900 computers, and parity memory cards based on 64K RAMs for A600+ and A700 computers. The new, high-density memory cards based on 256K RAMs can be used to provide up to 8 megabytes of ECC memory in A600+ or A700 computers, up to 21 megabytes of ECC memory without battery backup, 12 megabytes of ECC memory with battery backup in A900 computers.

Within the limitation of a maximum of four array cards in A600+ and A700 computers and systems, ECC memory systems can incorporate both the new 1 Mb or 2 Mb ECC memory array cards and existing parity memory cards (or ECC memory cards in A700 computers). Similarly, within the limitation of a maximum of eight array cards (four with battery backup), A900 computers can use a combination of the new 3 Mb ECC memory array cards and existing 768 kb ECC memory cards.

Interfaces and peripherals

A full line of HP manufactured interfaces and peripheral devices support the highly flexible configuration of one-vendor systems to satisfy a wide variety of application requirements.

Central processor descriptions

A900 Processor description

Cache memory for fast processing. Pipeline technology gives the A900 computer a superfast 133 nsec cycle time for each successful cache memory access. The cache incorporates hardware address create logic for fast next-address generation and supports a 32-bit data bus to the memory controller. With a hit rate typically 88%, memory access time averages about 181 nanoseconds.

A hardware floating point processor speeds floating point calculations. An integrated set of floating point chips accelerates processing for single and double precision floating point operations to real-time speeds — over 575,000 single precision additions or subtractions per second, over 535,000 multiplications per second, and over 250,000 divisions per second.

A Scientific Instruction Set (SIS) of nine single precision and nine double precision trigonometric and transcendental functions and a polynomial evaluation instruction uses the fast floating point computational power of the A900 to solve complex scientific and engineering calculations quickly and accurately. For example, the A900 can make over 65,000 single-precision square root calculations per second and over 38,000 hyperbolic tangent calculations per second.

A polynomial evaluation instruction included in the Scientific Instruction Set can evaluate polynomial expressions of the form:

$$Z = \frac{a + a_1x + a_2x^2 + \dots + a_nx^n}{b + b_1x + b_2x^2 + \dots + b_nx^n}$$

at hardware speeds. This capability is useful for function approximation, such as curve fitting or correction for non-linear response of a strain gage, thermocouple, or other transducer.

A Vector Instruction Set (VIS) applies the A900's floating point processing power to highly-efficient repetitive processing of vectors and matrices. Because they take advantage of the inherent efficiency of vector processing, the VIS instructions can achieve rates ranging from over 267,000 operations per second for single-precision vector divide to over 830,000 operations per second for vector add, subtract, and multiply, after initial setup times of 4 to 5 microseconds.

Error Correcting Code (ECC) Memory. A sizable 768k bytes of ECC memory, expandable to 21M bytes without battery backup, to 12M bytes with battery backup, is standard. The ECC capability corrects all single-bit errors without interrupting the operating system, which maximizes system integrity and reliability.

User microprogrammability is supported by an optional control store board and an easy-to-use, Pascal-like Paraphraser. This gives the user the ability to convert software routines that are frequently used or especially time consuming to microcoded routines that typically run 2 to 10 times faster.

A700 Processor description

Bit-slice central processor. The A700 computer is a bit-slice, microprogrammed machine on two CPU cards. Its memory controller supports one to four parity or Error Correcting Code (ECC) memory cards. Up to 8 megabytes of ECC memory can be provided.

User microprogrammability is supported by optional Writable and PROM Control Store cards and an easy-to-use Pascal-like Paraphraser. This gives user the ability to convert software routines that are frequently used or especially time consuming to microcoded routines that typically run 2 to 10 times faster.

An optional computation acceleration processor may be ordered as the 12156A Hardware Floating Point Processor card. This card provides hardware floating point computation speeds about 40% of A900 speeds plus Scientific and Vector Instruction Sets similar to those of the A900 with speeds about half as fast.

A600+ Processor description

Bit-Slice Central Processor. The A600+ computer is implemented on a single card with bipolar bit-slice microprocessors. The processor is a horizontally microprogrammed CPU with a 56-bit wide microword format. The wide microword format eliminates the need for time-consuming decode logic so the A600+ computer responds to microinstructions with maximum speed and efficiency, and provides high performance at surprisingly low cost.

1M bytes of memory and controller on a single card. The A600+ Memory Controller includes 128k bytes or 512k bytes of parity memory or 512k bytes or 1M byte of Error Correcting Code (ECC) memory on one card. Up to 8M bytes of ECC memory can be provided by adding memory cards to an A600+ computer with a 1M byte ECC memory controller.

NOTE: Hardware floating point and user microprogramming are not supported in the A600+ computer.

A-Series high-level program accelerator instructions

The A600, A700, and A900 Computers all include instructions designed to accelerate the execution speed of programs written in FORTRAN or Pascal. These microcoded routines speed up parameter passing and other commonly used high-level program operations 2 to 20 times, compared to the same routines in software.

Virtual Control Panel

A ROM-based Virtual Control Panel (VCP) program enables an operator to perform control panel functions via a local or remote-connected terminal or an adjacent HP 1000 Computer System through a standard serial, multiplexer (channel 1) or DS/1000-IV I/O interface card. Only one I/O interface card in the system can be given this capability at any one time. That I/O card can connect to a terminal or other computer system accessible only to the system manager or the maintenance department. The operator at the VCP terminal or system can examine and change the contents of registers and memory locations, control program execution, initiate the self test, and select a bootstrap loader and initiate the boot-up of a system.

Because of its remote operating ability, the VCP can be used for remote isolation of system faults, which can help to minimize support costs for OEM products that use the A-Series components. When not being used as the VCP, the VCP-assigned terminal can be used in the same way as any other terminal on the system, except for the break key.

Boot-up Sources and Auto Boot-up

The A-Series computers support boot-up from the following sources, of which sources 1 through 3 can be used for auto boot-up.

1. An adjacent HP 1000 System in a DS/1000-IV network via the 12007A/B or 12044A interface.
2. A disc memory via the 12009A HP-IB interface or other disc interface.
3. 12008A PROM Storage Module.
4. A 797xA/E Magnetic Tape Unit via the 12009A HP-IB interface.

Self Test and Diagnostics

The A-Series computers include microcoded and macro-coded self tests which check the CPU, memory, and the I/O masters of installed interfaces, either automatically on power-up or when requested by an operator via the Virtual Control Panel. HP 24612A, 24613A, and 24398B diagnostic packages are also available for stand-alone testing of all computer hardware, including I/O interfaces. A BASIC-like interpreter is provided in the 24612A package to help the user prepare diagnostics for user-designed interfaces.

Extensive software support

Operating System Software

- 92077A RTE-A Real-Time Executive operating system (for 512 kb to 21 Mb memory—included in 219xC/D Systems and 248xA Micro/1000 Systems)
- 92078A VC+ Enhancement to RTE-A operating system (included in 2197C/D and 2199C/D Systems)

Program Development Software

- 92836A FORTRAN 77 Compiler.
- 92833A Pascal/1000 Compiler.
- 92857A BASIC/1000C Interpreter-Compiler package.
- 92076A BASIC/1000L Interpreter.
- Macro/1000 Assembler (included in RTE-A).
- Edit/1000 Interactive Screen Editor (included in RTE-A).
- 92860A Symbolic Debug/1000.

Microprogram Development Software

- 92045A RTE Microprogramming Package for A700.
- 92049A RTE Microprogramming Package for A900.

Data Management Software

- Command Interpreter (included in RTE-A).
- File Manager (included in RTE-A).
- 96081A Image/1000-II Data Base Management System.
- 92069A Image/1000 Data Base Management System.

Graphics Software

- 92861A Version 2.0 Graphics/1000-II Device-Independent Graphics Library for general graphics support.
- 92862A Version 2.0 Graphics/1000-II Advanced Graphics Package for interactive and/or 3-D graphics support.

Communications Software

- 91750A DS/1000-IV Network software for communication with other HP 1000 systems or HP 3000 systems.
- 91751A DSN/X.25 software for communication with other systems via packet-switching networks.
- 91781A RJE/1000-II software for remote job entry to IBM or IBM plug-compatible systems.
- 91782A DSN/MRJE software for multileaving remote job entry to IBM or IBM plug-compatible compatible systems.
- 91784A PMF/1000 Programmable Mainframe facility software for program-to-program communication with IBM or IBM plug-compatible systems.
- 91732A Data Link Software for communication with multiple terminals and/or multiple systems via multipoint or data link lines.

Manufacturing Applications Software

- 92121A PMC/1000 Process Monitoring and Control Software
- 92131A QDM/1000 Quality Decision Management Software.
- 92141A PCIF/1000 Programmable Controller Interface Software.

Communications support

A-Series computers can communicate with terminals and other systems in the following ways:

- With terminals via single-channel interface, eight-channel multiplexer interface, or data link/multipoint interface.
- With other HP 1000 systems via DS/1000-IV HDLC point-to-point interface or multidrop Data Link.
- With HP 3000 systems via DS/1000-IV Bisync point-to-point interface.
- With HP 1000, HP 3000, and other systems via DSN/X.25 interface to packet-switching networks.
- With IBM or IBM plug-compatible system via Multi-Use Programmable Serial Interface and remote job entry or program-to-program communications software.

Input/output

Distributed Intelligence Architecture Boosts I/O Efficiency and Simplifies Programming

Computation and input/output are often both entirely controlled by the central processor. In A-Series computers, the central processor has been relieved of I/O DMA processing. That function has instead been assigned to an individual processor (IOP) on each interface card. Thus, the CPU is freer to process data. The CPU, the IOPs on each interface, and memory all communicate with each other via a common bus, except in the A900, which has a separate I/O bus.

Low-overhead I/O

I/O Processor-Managed DMA. The built-in intelligence of each IOP supports autonomous control of I/O operations. This includes high-speed direct memory access (DMA) and can even include chained multiple DMA transfers with CPU involvement only at the start and completion of the entire chain.

DMA Per Channel. The standard IOP is provided on every A-Series interface, supporting direct memory access (DMA) on all I/O channels.

I/O Access Priority. Priority of I/O interrupt and access to memory is controlled by interface card position on the card cage bus with respect to the CPU. The interface closest to the CPU has the highest priority, those farther down the bus have successively lower priority.

Simplified I/O Programming. The same level of intelligence that supports DMA-per-channel operation also simplifies I/O programming. The master IOP logic recognizes interface I/O addressing independently of I/O card position on the card cage bus. This supports standardization of I/O addresses and functions in programs without requiring any particular arrangement of I/O cards in the card cage.

Compatibility with other HP 1000 Computers

Compatibility with HP 1000 M/E/F-Series. A-Series computers execute the same HP 1000 base set instructions as HP 1000 M, E, and F-Series Except for dynamic mapping instructions, virtual memory instructions, and I/O instructions, other A-Series instructions beyond the base set as defined have the same mnemonics and format as in HP 1000 M, E, and F-Series computers, which facilitates program transportability between HP 1000 A-Series computers and HP 1000 M/E/F-Series computers.

I/O drivers written for use with the RTE-6/VM or RTE-IVB operating system will have to be rewritten for use with RTE-A.

Compatibility with HP 1000 L-Series. A-Series computers execute the entire L-Series instruction set. Programs written for use under RTE-L or RTE-XL will run without change under RTE-A.

Specifications

Central processor

Implementation: Microprogrammed LSI and MSI hardware.

Data path width: 16 bits.

A600+ and A700 Bus structure: Single backplane bus for memory, processor, and I/O.

A900 Bus structure: Single backplane bus for I/O, which accesses processor and memory via the cache memory.

VCP-Accessible Registers:

| | |
|---------------|--|
| A-Register | = 16-bit accumulator |
| B-Register | = 16-bit accumulator |
| X-Register | = 16-bit index register |
| Y-Register | = 16-bit index register |
| Q-Register | = 15-bit base register |
| P-Register | = 15-bit program counter |
| T-Register | = 16-bit memory transfer register |
| M-Register | = 15-bit manual data register |
| E-Register | = 1-bit extend register |
| O-Register | = 1-bit overflow register |
| CIR-Register | = 6-bit Central Interrupt register |
| V-Register | = 16-bit memory Violation register |
| Z-Register | = 16-bit bounds register |
| I-Register | = 1-bit Interrupt System status register |
| ES-Register | = 32-bit memory Error Syndrome register* |
| PE-Register | = 24-bit Parity Error address register** |
| WMAP-Register | = 16-bit logical map select register |

Register access: All registers can be selected for display or modification via the Virtual Control Panel.

Instruction formats: Combined single word, Single word, and Double word

Addressing modes: Direct, multilevel-indirect, single word, double word, and register implicit, indexed, and indirect indexed.

A900 Microcontrol processor

Implementation: Hardwired MSI, with pipelined data paths.

Instruction cycle time: 133 nanoseconds.

Control path: 48 bits

Data path: 16 bits.

* A900 only

** A600+ and A700 only

Registers:

| | |
|-------------------------|---|
| Standard registers | = 5 (A, B, X, Y, and Z) x 16 bits and 2 (P and Q) x 15 bits. |
| Scratch registers | = 2 x 16 bits, non-pipelined, 12 x 16 bits, pipelined, and 896 x 16 bits cache memory locations addressable as scratch registers. |
| Instruction register | = 1 x 16-bits. |
| Switch register | = 1 x 8-bits. |
| Status flag registers | = 2 x 1-bit. |
| LED register | = 1 x 8-bits. |
| Processor control | = 4 x 16-bits. |
| Processor status | = 4 x 16-bits and 3 x 8-bits. |
| Subroutine levels stack | = 16 x 15-bits and 3 x 16-bits. |
| Memory address | = 3 x 8-bits. |
| Microaddress vector | = 1 x 15-bits and 1 x 8-bits. |

Microinstruction formats:

- Type 1 Conditional special field execution or conditional return, all special fields available.
- Type 2 Conditional jump, conditional jump subroutine, 8-bit target address.
- Type 3 Unconditional jump, unconditional jump subroutine, 15-bit target address.
- Type 4 16-bit immediate data operations.

Bus structure: Two-address architecture. Three or four addresses allowed for some operands and registers. Multiple register stores available in the same cycle. Two separate store buses allow splitting of data paths. Separate data path for memory address registers. Main memory and I/O transactions are conducted on separate buses and are arbitrated by the cache.

Control memory structure:

| | |
|---------------|---|
| Type | = Bipolar LSI Semiconductor read/write or PROM. |
| Address space | = 32,768 words. |
| Word size | = 48 bits. |
| Cycle time | = 133 nanoseconds. |

Control processor instructions:

| | |
|----------------------|---|
| Number | = 265 total, up to 13 combinable in one instruction word. |
| Operations | = 8 total. |
| Special | = 45 total. |
| ALU | = 18 total. |
| Conditional | = 35 total. |
| Store | = 20 total. |
| Memory operations | = 8 total. |
| L Bus (source/store) | = 64 total. |
| R Bus (source/store) | = 64 total. |

A700 Microcontrol processor

Implementation: Hardwired MSI.

Instruction cycle time: 250 nanoseconds.

Control path: 32 bits.

Data path: 16 bits.

Registers:

| | |
|-------------------------|--|
| Standard registers | = 5 (A, B, X, Y, and Z) x 16-bits and 2 (P and Q) x 15-bits. |
| Scratch registers | = 43 x 16-bit registers available to the microprogrammer. |
| Instruction register | = 1 x 16-bits. |
| Switch/Ind. register | = 1 x 16-bits. |
| Status flag | = 1 x 1-bit. |
| Subroutine levels stack | = 4 x 14-bits. |
| Instruction register | = 1 x 16-bits. |

Microinstruction formats:

- Type 1 Macroinstruction decode and NOP, unconditional return.
- Type 2 Conditional return and conditional operation.
- Type 3 Conditional Jump and Jump to Subroutine.
- Type 4 Unconditional Jump and Jump to Subroutine.
- Type 5 Long Jump and Jump to Subroutine.
- Type 6 16-bit Immediate Data Operations.

Bus structure: Three-address architecture; one bus defaults to micro-accumulator with instruction types 3, 4, and 5. Memory and I/O data paths are through common backplane.

Control memory structure:

| | |
|---------------|---|
| Type | = Bipolar LSI Semiconductor read/write or PROM. |
| Address space | = 16,384 words. |
| Word size | = 32 bits. |
| Cycle time | = 250 nanoseconds. |

Control processor instructions:

| | |
|---------------------|--|
| Number | = 198 total, up to 7 combinable in one instruction word. |
| Operations | = 14 total. |
| Special | = 56 total. |
| ALU and Conditional | = 48 total. |
| Store (destination) | = 32 total. |
| B Bus (source) | = 32 total. |
| A Bus | = 16 total. |

Memory

Memory products and implementation: See Table 2.

ECC Memory in A600+ Computer: The 12110A/B 512 kb/1 Mb ECC Memory Controller is required for support of ECC memory in A600+ computers.

Intermixing of memory cards: ECC memory cards based on 256K RAMs can be mixed with parity or ECC memory cards based on 64K RAMs, if the cards based on 256K RAMs are installed between the memory controller (or CPU card in A600+ computers) and the cards based on 64K RAMs.

A900 Cache size: 4k bytes.

A900 Cache cycle time: 133 nanoseconds.

Table 2. A-Series Memory Products and Implementation

| MEMORY PRODUCT | CYCLE TIME IN A600+ | CYCLE TIME IN A700 | CYCLE TIME IN A900 |
|----------------|---------------------|--------------------|--------------------|
|----------------|---------------------|--------------------|--------------------|

THE FOLLOWING ECC MEMORY PRODUCTS ARE IMPLEMENTED WITH 256K DYNAMIC NMOS RAMS

| | | | |
|---|---------------|---------------|----------------------------|
| 12110A 512 kb ECC Memory Controller Card 12110B 1 Mb ECC Memory Controller Card | 454 ns | Not Supported | |
| 12111A 512 kb ECC Memory Array Card 12111B 1 Mb ECC Memory Array Card 12111C 2 Mb ECC Memory Array Card | 454 ns | 500 ns | Not Supported |
| 12221A 3 Mb ECC Memory Array Card | Not Supported | | 181 ns, average effective* |

THE FOLLOWING PARITY AND ECC MEMORY PRODUCTS ARE IMPLEMENTED WITH 64K DYNAMIC NMOS RAMS

| | | | |
|--|---------------|---------------|----------------------------|
| 12102A 128 kb Parity Memory Control Cd 12102B 512 kb Parity Memory Control Cd | 454 ns | Not Supported | |
| 12103A 128 kb Parity Memory Array Card 12103C 512 kb Parity Memory Array Card 12103D 1 Mb Parity Memory Array Card | 454 ns | 500 ns | Not Supported |
| 12103B 256 kb Parity Memory Array Card 12104A 512 kb ECC Memory Array Card | Not Supported | 500 ns | Not Supported |
| 12220A 768 kb ECC Memory Array Card | Not Supported | | 181 ns, average effective* |

* Assuming typical 88% cache "hit" rate; hit rate depends upon program locality.

A900 Cache fault processing time: Typically 539 nsec.

Memory structure: 32 pages of 2048 bytes with direct access to current or base page (page 00), indirect or indexed access to all other pages.

A900 Memory expansion: To 10.5k pages* using 12221A 3 Mb ECC Memory Array Cards.

A600+ or A700 Memory Expansion: To 4k pages* using ECC memory cards based on 256K RAMs.

Maximum A-Series memory supported by 12157A Battery Backup System: Four memory array cards (12M bytes in A900).

Memory protection: Write or read or read/write on a page-by-page basis.

* 2048 bytes per page

Error correction: A modified Hamming code is generated on all memory writes and stored for checking. All reads are monitored to check the accuracy of the stored data. All single-bit errors are corrected and all double-bit errors are detected. The system ignores single-bit (corrected) errors. Other detected errors are signalled as a memory error interrupt.

Floating point data formats

Single-precision: 32 bits (4 bytes), providing at least 6 significant decimal digits in mantissa.

Double-precision: 64 bits (8 bytes), providing at least 16 significant decimal digits in mantissa.

Exponent range: 2^{-128} to 2^{+127} in all floating point numbers.

Decimal equivalent: Approximately 10^{+38} .

Fixed point data formats

Single-precision: 16 bits (2 bytes), twos complement integer.

Double-precision: 32 bits (4 bytes), twos complement integer.

Scientific Instruction Set Data Formats and Accuracy (A700 Opt 001 and A900 only)

Scientific Instruction Set Data Formats: Single- and double-precision floating point.

Scientific Instruction Set Accuracy: See Table 3.

Table 3. Scientific Instruction Set Accuracy

| SCIENTIFIC INSTRUCTION SET FUNCTIONS | RMS RELATIVE ERROR | |
|--------------------------------------|--------------------|------------------|
| | SINGLE-PRECISION | DOUBLE-PRECISION |
| Sine | 9.2E-8 | 1.2E-16 |
| Cosine | 7.7E-8 | 1.3E-16 |
| Tangent | 1.5E-7 | 1.9E-16 |
| Arc Tangent | 1.5E-7 | 2.3E-16 |
| Hyperbolic Tangent | 2.2E-7 | 5.5E-16 |
| Square Root | 6.7E-8 | 1.6E-17 |
| Exponentiation | 3.2E-7 | 8.8E-17 |
| Natural Logarithm | 1.2E-7 | 1.3E-16 |
| Base 10 Logarithm | 1.6E-7 | 1.3E-16 |



Interrupt system

Vectored priority interrupt structure with the following priority assignments and select codes. Note that select codes do not necessarily match priorities.

| Priority | Select Code | Interrupt Function |
|----------|-------------|--------------------------------|
| 1 | 00005 | Parity Error |
| 2 | 00010 | Unimplemented Instruction |
| 3 | 00007 | Memory Protect Violation |
| 4 | 00004 | Power Fail Warning |
| 5 | 00017 | VCP Break |
| 6 | 00006 | Time Base Generator "Tick" |
| 7 | 00011-00016 | Reserved for special functions |
| 8+ | 00020-00077 | I/O Device Interrupts |

Power fail provisions: When primary line power falls below a predetermined level while the CPU is running, a power fail warning signal from the power supply causes an interrupt to memory location 00004. Memory location 00004 is intended to contain a Jump-to-subroutine (JSB) instruction to a power fail subroutine, such as that included in RTE-A. A minimum of 5 milliseconds is available to execute the power fail subroutine.

Battery backup and auto restart: Battery backup of memory by the 12154A Battery Backup Card in Micro/1000 systems or the 12157A Battery Backup System in A-Series systems or computers makes possible auto restart after power failure. Restoration of power triggers a memory saved signal if the backup battery has not fully discharged. The memory saved signal enables the CPU to automatically jump to and resume execution of the program that was running when the power failed.

Memory protect: Memory protect logic on the CPU:

1. Protects memory on a page-by-page basis against alteration or entry by programmed instructions, except those involving the A and B registers. A memory protect violation instruction will interrupt the CPU and the address of the violating will be saved in a register on the memory controller card, from which it can be made accessible in the A or B register by a single Assembly language instruction.
2. Prohibits execution of privileged instructions (mapping instructions and all I/O instructions except those referencing select code 01, the CPU status register and the overflow register). This limits control of I/O and mapping operations to the operating system or other privileged programs.

Time base generator interrupt: A time base generator interrupt is provided for maintaining a real-time clock. The interrupt request is made when the CPU signals, at 10-millisecond intervals, that its internal clock is ready to roll over. Timing accuracy of the time base generator is ± 2.16 seconds per (24 hour) day.

Unimplemented instruction interrupt: An unimplemented instruction interrupt is requested when the CPU signals that the last instruction fetched was not recognized. This

interrupt provides a straightforward entry to software routines for the execution of instruction codes not recognized by the CPU.

I/O Master Processor

Purpose: To maintain the high performance of the CPU, an I/O Master Processor is used as the standard input/output interface circuit to the A-Series system backplane. The I/O Master includes an I/O processor chip, which executes I/O instructions, and other circuits that make high speed transfer possible. Every A-Series I/O interface card has the I/O Master processor.

Determination of I/O address: I/O address select code is set for each interface by select code address switches on the interface and is therefore independent of interface card position along the backplane bus.

I/O addressing: An I/O interface is pre-addressed by presetting its select code into a Global Register (GR). Thereafter, this leaves the six select code bits of I/O instructions available for addressing registers or for other functions on the interface.

I/O device interrupt priority: Priority depends upon I/O interface card position along the backplane, with respect to the CPU card.

I/O interrupt procedure:

1. One or more I/O interfaces requests an interrupt.
2. The CPU responds to the interrupt request of the highest priority interface (that closest to the CPU) by executing the instruction in a memory location that corresponds to the select code of the interface.

Interrupt masking: The I/O Master logic includes an interrupt mask register which provides for selective inhibition of interrupts from specific interfaces under program control. This capability can be programmed to temporarily cut off undesirable interrupts from any combination of interfaces when they could interfere with crucial transfers.

Interrupt latency when there is no DMA interference:

| Computer | Specification* | |
|----------|-----------------------|------------------------|
| A900 | 3.7 to 13 μ sec, | 4 μ sec, typical |
| A700 | 8 to 29.75 μ sec, | 10 μ sec, typical |
| A600+ | 4.7 to 40 μ sec, | 5.1 μ sec, typical |

*Interrupts cannot be serviced until a DMA cycle or an instruction in progress has completed execution. The worst-case latency is based upon time to complete the longest uninterruptible instruction. Instructions with longer total execution times are interruptible.

Self-configured, chained DMA: The IOP chip also supports a self-configuring mode of operation. In this mode, instead of interrupting after a block transfer, the IOP fetches a new set of control words for the next transfer, reconfigures itself, and initiates a block transfer. This process continues as long as additional sets of control words are available.

Data packing under DMA: When byte mode is specified in control word instructions, the IOP automatically packs or unpacks bytes.

Maximum achievable DMA rate (I/O Bandwidth):

| Computer | Input | Output |
|----------|------------------------------|---------------------------|
| A900 | 3.7 Mb/sec (1.85 Mw/sec) | 2.5 Mb/sec (1.25 Mw/sec) |
| A700 | 4 Mb/sec (2 Mw/sec) | 4 Mb/sec (2 Mw/sec) |
| A600+ | 4.27 Mb/sec (2.13 Mw/sec) | 4.27 Mb/sec (2.13 Mw/sec) |

Self-configured DMA timing between successive block transfers of a chained series:

| Computer | Timing |
|----------|-------------------------|
| A900 | 5.2 to 8.1 microseconds |
| A700 | 5.0 to 7.7 microseconds |
| A600+ | 4.5 to 7.1 microseconds |

I/O Master signals and timing: See the HP 1000 L-Series I/O interfacing guide (02103-90005).

Instruction repertoire and execution times: See Table 4.

Safety and EMI qualification

See the Microsystem, System, Computer, and Board Computer data sheets.

Physical characteristics

See the Microsystem, System, Computer, and Board Computer data sheets.

Ordering information

See the Microsystem, System, Computer, and Board Computer data sheets.

Table 4. Instruction Repertoire and Execution Times

NOTE: Actual times may vary from those listed below. Memory refresh during a processor memory access, heavy DMA activity, and "misses" in the A900 cache will all degrade (lengthen) instruction times.

| Instruction | Execution Time (microseconds) in | | | |
|---|----------------------------------|------------|------------|-------------|
| | A900 | A700 | A700 w/FPP | A600+ |
| MEMORY REFERENCE INSTRUCTIONS | | | | |
| ADA/B, IOR, XOR, AND - LDA/B | 0.267 | 1.00 | 1.00 | 0.908 |
| STA/B - STA/B,I | 0.400 | 1.00-1.50 | 1.00-1.50 | 1.362-1.589 |
| CPA/B without skip - with skip | 0.533 | 1.50-1.75 | 1.50-1.75 | 1.135 |
| ISZ without skip - with skip | 0.533 | 1.50-1.75 | 1.50-1.75 | 1.362 |
| JSB/JSB,I | 0.533/0.667 | 1.50 | 1.50 | 1.362/1.589 |
| JMP/JMP,I | 0.133/0.267 | 0.75/1.50 | 0.75/1.50 | 0.681/1.362 |
| Each indirect address level, except the first for JSB,I or JMP,I or STA/B,I | 0.133 | 0.50 | 0.50 | 0.454 |
| ALTER-SKIP INSTRUCTIONS | | | | |
| All instructions and combinations | 0.267-0.533 | 0.75-2.25 | 0.75-2.25 | 1.135-1.362 |
| SHIFT-ROTATE INSTRUCTIONS | | | | |
| All instructions and combinations | 0.267 | 0.75-3.00 | 0.75-3.00 | 1.135-2.270 |
| EXTENDED ARITHMETIC INSTRUCTIONS | | | | |
| DLD/DST | 0.533 | 2.50/2.25 | 2.50/2.25 | 1.816/2.043 |
| MPY | 2.267 | 6.25 | 6.25 | 5.498 |
| DIV | 6.267 | 8.50-9.50 | 8.50-9.50 | 2.497-10.44 |
| ASL with one shift/per additional ASL shift | 0.800/0.000 | 2.25/0.50 | 2.25/0.50 | 1.816/0.454 |
| LSL/RRL with one shift | 0.400 | 2.00 | 2.00 | 1.135 |
| ASR/LSR with one shift | 0.667 | 2.00 | 2.00 | 1.362/1.135 |
| RRR with one shift/RRR 16 (Swap) | 0.667 | 2.25/1.50 | 2.25/1.50 | 1.589/1.816 |
| Per additional LSL/RRL/ASR/LSR/RRR shift | Zero | 0.25 | 0.25 | 0.227 |
| JLA/B | 0.533 | 1.50 | 1.50 | 1.362 |
| INPUT/OUTPUT INSTRUCTIONS | | | | |
| HLT,xx | 3.067 | 30.00 | 30.00 | 17.49 |
| Select code 00: | | | | |
| STF/CLF | 0.667/0.933 | 5.75/3.50 | 5.75/3.50 | 1.362 |
| SFC, SFS skip/no skip | 0.933 | 4.25 | 4.25 | 1.589 |
| LIA/B - OTA/B | 3.067-3.867 | 6.75-6.50 | 6.75-6.50 | 6.356-4.944 |
| CLC - STC | 2.000-0.400 | 8.50 - N/A | 8.50 - N/A | 1.362 |

N/A = Not Applicable

N/S = Not Specified

Table 4. Instruction Repertoire and Execution Times (Continued)

| Instruction | Execution Time (microseconds) in | | | | |
|---|---|--|--|--|---|
| | A900 | A700 | A700 w/FPP | A600+ | |
| INPUT/OUTPUT INSTRUCTIONS, continued | | | | | |
| Select code 01: | STF, CLF - STC, CLC SFC, SFS skip/no skip LIA/B - OTA/B | 0.267 0.400 1.867-0.400 | 2.00 - N/A 2.75/2.50 16.75-2.75 | 2.00 - N/A 2.75/2.50 16.75-2.75 | 1.362 1.362 1.362 |
| Select code 02: | STF/CLF STC CLC SFC, SFS skip/no skip LIA/B - OTA/B | 0.800 0.800 0.800 0.800 3.067-3.600 | 4.75/4.00 3.50 N/A 4.75/4.50 6.75-6.00 | 4.75/4.00 3.50 N/A 4.75/4.50 6.75-6.00 | 2.043 2.043 N/A 1.589 6.356-4.767 |
| Select code 03: | CLC - STC, CLF, SFS, and SFC STF LIA/B - OTA/B | 0.400 1.067 3.067-3.333 | N/A N/A 6.75-6.00 | N/A N/A 6.75-6.00 | N/A N/A 6.356-5.488 |
| Select code 04: | STF CLF - SFC/SFS LIA/B - OTA/B STC/CLC | 2 millisec* 0.400-0.800 0.533 0.667 | N/A N/A 2.75-3.00 4.50/3.50 | N/A N/A 2.75-3.00 4.50/3.50 | N/A N/A 1.362 1.589 |
| Select code 05: (Memory Error) | STF/CLF SFC, SFS skip/no skip LIA/B - OTA/B STC, CLC | 0.400 0.400 0.800-2.133 0.800 | 2.50/2.75 3.25/3.00 3.00 - N/A 2.75 | 2.50/2.75 3.25/3.00 3.00 - N/A 2.75 | 1.362 1.589 1.589 1.362 |
| Select code 06: (Time Base Generator "Tick") | STF/CLF SFC, SFS skip/no skip LIA/B - OTA/B STC/CLC | 0.800 0.800 0.400 0.800 | 5.00/3.25 3.75/3.50 N/A 3.00/4.50 | 5.00/3.25 3.75/3.50 N/A 3.00/4.50 | 1.362 1.589 1.362-1.816 2.951/3.632 |
| Select code 07: (Memory Protect Violation) | CLF/CLC - STF STC LIA/B - OTA/B SFC, SFS skip/no skip | 0.400-0.800 0.933 0.533-0.400 0.400 | N/A 3.00 3.25 - N/A N/A | N/A 3.00 3.25 - N/A N/A | N/A 1.362 1.362 N/A |
| Select code >= 20: (I/O Interfaces) | STC, CLC STF, CLF SFC, SFS skip/no skip LIA/B, MIA/B - OTA/B | 1.333-2.667 1.200 2.400/1.333 3.067-3.333 | 3.50 3.50 5.25/3.50 6.00-5.25 | 3.50 3.50 5.25/3.50 6.00-5.25 | 2.951 2.951 4.086/2.951 5.902-4.994 |
| OPERATING SYSTEM INSTRUCTIONS | | | | | |
| .WFI (Basic + Loop) | | Until int. 0.667/0.400 | Until int. 1.50/1.25 | Until int. 1.50/1.25 | Until int. 0.908 |
| .SIP/CPUID | | 1.733 | 2.50 | 2.50 | 0.908 |
| .FWID | | | | | |
| HIGH LEVEL PROGRAM EXECUTION ACCELERATOR INSTRUCTIONS | | | | | |
| .ENTR/.ENTP (basic, see "Add'l per word") | | 1.600 | 4.75/5.25 | 4.75/5.25 | 2.724/2.951 |
| .ENTN/.ENTC (basic, see "Add'l per word") | | 1.200 | 4.00/4.25 | 4.00/4.25 | 2.270 |
| Additional per word, assuming no indirects | | 0.267 | 1.00 | 1.00 | 0.908 |
| Additional for each indirect address level | | 0.133 | 1.00 | 1.00 | 0.454 |
| .CPM | | 1.200 | 3.50-4.25 | 3.50-4.25 | 2.951 |
| .SETP + Additional per word | | 1.067+0.267 | 3.25+0.50 | 3.25+0.50 | 2.724+0.454 |
| .FCM | | 1.600 | 1.50-6.50 | 1.50-6.50 | 1.135-5.448 |
| .TCM | | 2.267 | N/A | 7.00 | 9.761-10.44 |
| .NGL | | 2.400 | N/A | 6.75 | 4.540-8.399 |
| .BLE | | 1.600 | N/A | 6.25 | 5.221 |
| .DFER/.CFER | | 1.600/1.867 | 5.75/7.00 | 5.75/7.00 | 4.767/5.675 |
| .ZFER/.XFER | | 2.933/1.333 | 11.00/4.50 | 11.00/4.50 | 9.761/3.859 |
| .FLUN | | N/A | N/A | N/A | 1.362 |
| .PACK | | N/A | N/A | N/A | 1.816-9.988 |
| .PWR2 | | N/A | N/A | N/A | 1.362-3.178 |
| EXTENDED INSTRUCTION GROUP | | | | | |
| ADX, ADY/LDX, LDY | | 0.400 | 1.75 | 1.75 | 1.589/1.362 |
| CAX, CBX, CAY, CBY, CXA, CXB, CYA, CYB | | 0.400 | 0.75 | 0.75 | 0.908 |
| DSX, DSY, ISX, ISY skip/no skip | | 0.667 | 1.25 | 1.25 | 1.135 |
| LAX, LBX, LAY, LBY/STX, STY | | 0.533 | 2.25/1.75 | 2.25/1.75 | 1.589 |
| SAX, SAY, SBX, SBY/XAX, XAY, XBX, XBY | | 0.533 | 2.25/1.25 | 2.25/1.25 | 1.816/1.135 |
| JLY/JPY | | 0.533/0.400 | 1.75 | 1.75 | 1.135 |
| Each indirect address level | | 0.133 | 0.50 | 0.50 | 0.454 |
| BIT MANIPULATION INSTRUCTIONS | | | | | |
| CBS, SBS | | 0.800 | 3.50 | 3.50 | 2.724 |
| TBS skip/no skip | | 0.800 | 3.50 | 3.50 | 2.951 |

N/A = Not Applicable N/S = Not Specified * = Flushes cache

Table 4. Instruction Repertoire and Execution Times (Continued)

| Instruction | Execution Time (microseconds) in | | | |
|--|----------------------------------|-------------|------------|-------------|
| | A900 | A700 | A700 w/FPP | A600+ |
| BYTE MANIPULATION INSTRUCTIONS | | | | |
| CBT | 1.467 | 4.25 | 4.25 | 2.270 |
| Additional for 2 bytes in A900 | 0.400 | N/A | N/A | N/A |
| Additional per byte in A700 or A600+ | N/A | 2.33 | 2.33 | 3.589 |
| LBT, odd/even byte | 0.667/0.800 | 1.75 | 1.75 | 1.816/2.270 |
| MBT | 1.333 | 4.25 | 4.25 | 4.313-6.129 |
| Additional per byte | 0.133 | 2.33 | 2.33 | 0.454-1.022 |
| SBT | 0.933 | 2.50 | 2.50 | 2.270-2.724 |
| SFB, compare exit/terminal exit | 1.733 | 1.50 | 1.50 | 2.497-2.724 |
| Additional for 2 bytes in A900 | 0.400 | N/A | N/A | N/A |
| Additional per byte in A700 or A600+ | N/A | 1.50 | 1.50 | 1.135 |
| WORD MANIPULATION INSTRUCTIONS | | | | |
| CMW | 1.733 | 3.75 | 3.75 | 2.755 |
| Additional for four words in A900 | 1.200 | N/A | N/A | N/A |
| Additional per word in A700 or A600+ | N/A | 1.25 | 1.25 | 1.135 |
| MWV+Additional per word | 0.933+0.267 | 3.75+1.00 | 3.75+1.00 | 2.270+0.908 |
| DYNAMIC MAPPING INSTRUCTIONS | | | | |
| XLA1/B1, XSA1/B1, XLA2/B2, XSA2/B2 | 0.800 | 2.75 | 2.75 | 1.589-1.816 |
| XCA1/B1 skip/no skip & XCA2/B2 no skip | 1.067 | 3.25 | 3.25 | 1.816 |
| MB00/01/02/10/11/12/20/21/22 | 1.600+0.133 | 3.50-5.00 | 3.50-5.00 | 1.589-3.405 |
| Additional per byte | 0.133 | 1.00-1.25 | 1.00-1.25 | 2.270-2.724 |
| MW00/11/22 + Additional per word | 1.067+0.267 | 3.50+1.00 | 3.50+1.00 | 2.724+0.908 |
| MW01/02/10/12/20/21 + Additional per word | 1.067+0.267 | 3.50+1.00 | 3.50+1.00 | 2.724+1.135 |
| LPMP/SPMP | 0.933 | 1.50/1.25 | 1.50/1.25 | 3.632 |
| LDMP/STMP | 9.200/9.333 | 20.0 | 20.0 | 38.14/38.36 |
| LWD1/LWD2 | 1.333/1.200 | 2.5 | 2.5 | 1.362 |
| SWMP/SIMP | 0.667 | 5.0/2.0 | 5.0/2.0 | 3.859/2.724 |
| XJMP | 1.867 | 5.75 | 5.75 | 4.086 |
| XJCQ | 2.000 | 7.25 | 7.25 | 5.448 |
| VIRTUAL MEMORY INSTRUCTIONS | | | | |
| NOTE: The following times do not include access time to bring in data from the disc. | | | | |
| .LBP/.LBPR | 1.733/2.000 | 6.25/7.00 | 6.25/7.00 | 10.67/11.80 |
| .LPX/.LPXR | 2.133/2.533 | 7.75/9.00 | 7.75/9.00 | 12.03/13.85 |
| .IMAP (Basic) | 3.600 | 9.75 | 9.75 | 23.15# |
| .IRES (Basic) | 1.733 | 5.00 | 5.00 | 13.39# |
| Additional per .IMAP or .IRES parameter | 2.000 | 9.75-14.75 | 6.50 | 10.44 |
| .JMAP (Basic) | 3.200 | 9.75 | 9.75 | 36.09# |
| .JRES (Basic) | 1.333 | 5.50 | 5.50 | 26.11 |
| Additional per .JMAP or .JRES parameter | 2.000 | 11.00-26.00 | 7.50 | 9.307 |
| .PMAP | 1.600 | 5.00 | 5.00 | 7.264 |
| CODE AND DATA SEPARATION (VC+) INSTRUCTIONS | | | | |
| CACQ, CBCQ | 0.533 | 1.50 | 1.50 | 1.362-1.589 |
| CCQA, CCQB | 0.533 | 1.00 | 1.00 | 0.908 |
| CAZ, CBZ, CZA, CZB, ADQA, ADQB | 0.533 | 1.00 | 1.00 | 0.908 |
| CIQA, CIQB | 0.667 | 1.50 | 1.50 | 1.589 |
| SDSP (Basic + Add'l per element of display) | 0.933+0.400 | 2.75+1.00 | 2.75+1.00 | 2.043+0.908 |
| PCALI (Basic, see add'l per parameter) | 1.867 | 5.50 | 5.50 | 4.540 |
| PCALX (Basic, see add'l per parameter) | 7.84 | 21.50 | 21.50 | 22.70 |
| PCALV (Basic, see add'l per parameter) | 7.98 | 23.00 | 23.00 | 23.15 |
| PCALR (Basic, see add'l per parameter) | 2.667 | 8.75 | 8.75 | 7.264 |
| PCALN (Basic, see add'l per parameter) | 2.667 | 8.00 | 8.00 | 6.810 |
| Additional per PCAL_ parameter) | 0.400 | 1.50 | 1.50 | 0.908 |
| EXIT without/with segment mapping | 0.931/6.11 | 2.50/15.00 | 2.50/15.00 | 2.270/19.52 |
| EXIT1 without/with segment mapping | 0.931/6.11 | 2.75/15.25 | 2.75/15.25 | 2.497/19.75 |
| EXIT2 without/with segment mapping | 1.064/6.11 | 2.75/15.25 | 2.75/15.25 | 2.730/19.98 |
| DOUBLE INTEGER INSTRUCTIONS | | | | |
| DAD | 0.800 | 2.50-3.50 | 2.50-3.50 | 2.497 |
| DSB, .DSBR | 0.800 | 3.25-3.50 | 3.25-3.50 | 2.497 |
| .DIN, .DDE/.DNG | 0.667/0.933 | 1.75 | 1.75 | 1.135/1.589 |
| .DIS | 0.933 | 2.75-3.25 | 2.75-3.25 | 3.859 |
| .DDS | 0.933 | 3.00 | 3.00 | 3.859 |
| .DCO | 1.333 | 3.25-3.50 | 3.25-3.50 | 2.497-2.951 |
| .DMP | 2.400 | 16.75-27.00 | 5.0 | 3.178-13.85 |
| .DDI | 5.200 | 9.25-73.10 | 9.25-10.25 | 3.632-16.34 |
| .DDIR | 5.333 | 9.50-73.50 | 9.00-10.00 | 4.450-17.48 |

N/A = Not Applicable N/S = Not Specified # = With one parameter

Table 4. Instruction Repertoire and Execution Times (Continued)

| Instruction | Execution Time (microseconds) in | | | |
|-------------|----------------------------------|------|------------|-------|
| | A900 | A700 | A700 w/FPP | A600+ |

SINGLE-PRECISION FLOATING POINT INSTRUCTIONS

Times listed are for built-in floating point hardware in A900, for floating point firmware and optional floating point processor in A700, and for floating point firmware in A600+.

| | | | | |
|-----------------------------------|-------|-------------|-----------|-------------|
| .FAD | 1.733 | 7.75-26.00 | 4.75 | 8.853-17.71 |
| .FSB | 1.733 | 7.75-26.00 | 4.75 | 9.534-18.84 |
| .FMP | 1.867 | 13.75-25.25 | 4.50 | 17.03-21.11 |
| .FDV | 4.000 | 18.25-29.75 | 7.00 | 5.448-27.92 |
| Conv from single integer (.FLOAT) | 1.867 | 1.75-6.50 | 3.50 | 2.270-5.675 |
| Conv from double integer (.FLTD) | 2.000 | N/S | 3.75 | 1.589-7.037 |
| Conv to single integer (.FIX) | 1.733 | 1.50-6.50 | 1.75-3.50 | 2.497-6.356 |
| Conv to double integer (.FIXD) | 2.133 | N/S | 4.00 | 1.816-7.945 |

DOUBLE-PRECISION FLOATING POINT OPERATIONS

Times listed are for built-in floating point hardware in A900, optional floating point processor (FPP) in A700, and floating point firmware in A600+.

| | | | | |
|--|-------|-----|-------|-------------|
| .TADD | 3.467 | N/A | 9.50 | 11.35-27.92 |
| .TSUB | 3.467 | N/A | 9.50 | 12.94-29.51 |
| .TMPY | 3.467 | N/A | 9.50 | 11.35-64.01 |
| .TDIV | 8.533 | N/A | 14.75 | 12.94-65.15 |
| Conversion from single integer (.TFTS) | 1.867 | N/A | 5.00 | 4.540-8.853 |
| Conversion from double integer (.TFTD) | 2.000 | N/A | 5.25 | 5.221-9.988 |
| Conversion to single integer (.TFXS) | 2.267 | N/A | 5.00 | 4.086-8.626 |
| Conversion to double integer (.TFXD) | 2.400 | N/A | 5.25 | 4.313-9.761 |

SINGLE-PRECISION SCIENTIFIC INSTRUCTION SET INSTRUCTIONS

Times listed are for built-in Scientific Instruction Set in A900 or Scientific Instruction Set that is included with the optional floating point processor in A700.

| | | | | |
|------------------------------|---------|-----|---------|-----|
| Sine/Cosine | 18 - 20 | N/A | 25 - 29 | N/A |
| Tangent | 21 - 25 | N/A | 27 - 32 | N/A |
| Arc Tangent | 14 - 22 | N/A | 18 - 28 | N/A |
| Hyperbolic Tangent | 10 - 26 | N/A | 3 - 39 | N/A |
| Exponentiation | 19 | N/A | 29.5 | N/A |
| Natural or Base 10 Logarithm | 19 | N/A | 28 | N/A |
| Square Root | 15 | N/A | 21 | N/A |

VECTOR INSTRUCTION SET (VIS) INSTRUCTIONS

Setup times (listed first) and times per Vector/Matrix element (listed second) are for built-in Vector Instruction Set in A900 and Vector Instruction Set that is included with the optional hardware floating point processor in A700.

-- SINGLE-PRECISION VIS INSTRUCTIONS

| | | | | |
|---|-------------|-----|------------|-----|
| .VADD, .VSUB (Setup+time per vector element) | 4.9 +1.2 | N/A | 13.5 +3.75 | N/A |
| .VMPLY (Setup+time per vector/matrix element) | 5.1 +1.2 | N/A | 13.5 +3.75 | N/A |
| .VDIV (Setup+time per vector/matrix element) | 4.3 +3.7 | N/A | 13.5 +7.00 | N/A |
| .VSAD, .VSSB (Setup+time per vector element) | 4.8 +1.1 | N/A | 14.0 +2.50 | N/A |
| .VSMY, .VSSY (Setup+time per vector/matrix element) | 5.1 +1.2 | N/A | 14.0 +2.25 | N/A |
| .VSDV (Setup+time per vector/matrix element) | 3.7 +3.7 | N/A | 14.0 +5.25 | N/A |
| .VPIV (Setup+time per vector/matrix element) | 6.8 +1.6 | N/A | 14.5 +4.50 | N/A |
| .VABS (Setup+time per vector/matrix element) | 4.8 +1.1 | N/A | 11.5 +2.75 | N/A |
| .VSUM (Setup+time per vector/matrix element) | 4.0 +2.4 | N/A | 12.8 +3.00 | N/A |
| .VNRM (Setup+time per vector/matrix element) | 4.4 +2.4 | N/A | 13.3 +3.00 | N/A |
| .VDOT (Setup+time per vector/matrix element) | 8.0 +3.2 | N/A | 16.3 +6.50 | N/A |
| .VMAX, .VMIN (Setup+time per vector element) | 4.1+0.7-2.7 | N/A | 11+2.3-5.3 | N/A |
| .VMAB, .VMIB (Setup+time per vector element) | 4.1+2.1-2.5 | N/A | 11+4.3-5.5 | N/A |
| .VMOV (Setup+time per vector/matrix element) | 2.8 +0.7 | N/A | 8.5 +2.00 | N/A |
| .VSWP (Setup+time per vector/matrix element) | 2.8 +1.2 | N/A | 8.5 +4.00 | N/A |

-- DOUBLE-PRECISION VIS INSTRUCTIONS

| | | | | |
|---|-------------|-----|-------------|-----|
| DVADD, DVSUB (Setup+time per vector element) | 6.1 +2.0 | N/A | 13.5 +6.25 | N/A |
| DVMPLY (Setup+time per vector/matrix element) | 6.1 +2.0 | N/A | 13.5 +6.50 | N/A |
| DVDIV (Setup+time per vector/matrix element) | 4.7 +7.2 | N/A | 13.5 +12.25 | N/A |
| DVSAD, DVSSB (Setup+time per vector element) | 5.7 +1.6 | N/A | 14.8 +4.50 | N/A |
| DVSMY, DVSSY (Setup+time per vector/matrix element) | 5.9 +1.6 | N/A | 14.8 +4.75 | N/A |
| DVSDV (Setup+time per vector/matrix element) | 4.0 +7.2 | N/A | 15.8 +10.25 | N/A |
| DVPIV (Setup+time per vector/matrix element) | 8.4 +2.7 | N/A | 17.8 +8.00 | N/A |
| DVABS (Setup+time per vector/matrix element) | 5.6 +1.6 | N/A | 12.5 +4.75 | N/A |
| DVSUM (Setup+time per vector/matrix element) | 4.1 +2.1 | N/A | 15.0 +3.25 | N/A |
| DVNRM (Setup+time per vector/matrix element) | 4.5 +2.1 | N/A | 15.5 +3.25 | N/A |
| DVDOT (Setup+time per vector/matrix element) | 7.4 +2.5 | N/A | 18.0 +6.50 | N/A |
| DVMAX, DVMIN (Setup+time per vector element) | 4.3+0.7-3.3 | N/A | 13+2.3-6.3 | N/A |
| DVMAB, DVMIIB (Setup+time per vector element) | 4.3+2.5-3.2 | N/A | 13+5.3-6.5 | N/A |
| DVMOV (Setup+time per vector/matrix element) | 3.1 +1.2 | N/A | 9.5 +4.00 | N/A |
| DVSWP (Setup+time per vector/matrix element) | 3.1 +2.3 | N/A | 9.5 +8.00 | N/A |

N/A = Not Applicable N/S = Not Specified

Model 26, 27, and 29 Computer Systems



HP 1000 A-Series Computer Systems

product numbers
2196C/D, 2197C/D, and 2199C/D

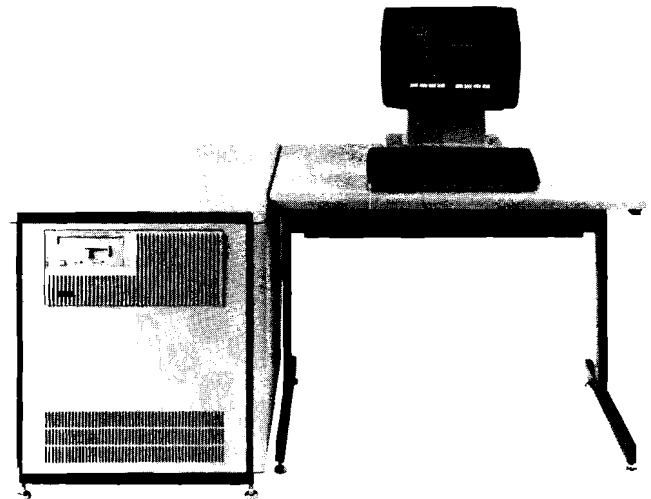
The Model 26, 27, and 29 are identically-packaged Computer Systems that are configured around the A600+, A700, and A900 computers and other basic system elements, which make up System Processor Units (SPU), product numbers 2196C/D, 2197C/D, and 2199C/D. (See the A-Series Computer Design and Specifications data sheet on page 1 for comparison of A600+, A700, and A900 capabilities.) These computer systems are managed by the RTE-A Real-Time Executive operating system, which supports multiprogramming, high-level program languages, the 92078A VC+ extension for large-program support, which is included in the 2197C/D and 2199C/D, virtual memory and sharable extended memory areas for data, data base management, distributed systems networking, graphics software, and memory up to 21 megabytes.

The SPU hardware consists of the A600+ CPU, A700 CPU with 12156A Hardware Floating Point Processor, or A900 CPU; 512 kilobytes or 768 kilobytes of memory, HP-IB disc interface card, and serial interface card in a 20-slot card cage. The card cage is housed in a 1.6m (63-inch) cabinet (219xC SPU) with rack space available for additional equipment or a 72cm (28.3-inch) cabinet (219xD SPU) without spare rack space.

To the SPU, OEMs and end users add an operator terminal, one or more hard discs, and other peripheral devices as needed for their applications. Multiple fixed discs with 24 to 404 megabyte capacity, some with built-in tape cartridge backup, can be used on the system. Up to 1.6 gigabytes of disc capacity can be connected via a single disc interface, using 404 megabyte discs.

Features

- Integrated system building block for OEMs and end users designing their own A-Series based application products
- 1.6m cabinet with rack space for additional user equipment (219xC only)
- Disc memory expandable to 1.6 gigabytes on one card cage slot with multiple discs
- Extensive software support, including:
 - Real-time multiprogram executive operating system
 - FORTRAN 77, Pascal, BASIC, and Macroassembler programming plus interactive screen editor, and Symbolic Debug/1000 for program development
 - Image/1000 Data Base Management software
 - Graphics/1000-II software
- Large program and data capacity support with:
 - VC+ capability for programs up to 7.75 megabytes is standard in Model 27 and 29 systems, optional in Model 26 systems
 - Virtual memory for data divided between main memory and disc, supports transparent processing of data arrays up to 128 megabytes
 - Multiple sharable Extended Memory Areas (EMAs) for data arrays up to 2 megabytes resident in main memory. Up to 15 EMAs are supportable, each sharable by as many as 63 programs
- Instruction and program compatibility with other members of the HP 1000 family protects software of current OEMs and end users and gives users access to a broad base of proven software
- Built-in dynamic mapping system, memory protect, time base generator, and self test
- Power fail detection and auto restart with optional 12157A Battery Backup System



- DS/1000-IV Distributed Systems Networking software
- Three packages for communication with IBM or IBM plug-compatible systems
- PMC/1000 for process monitoring and control
- QDM/1000 for quality data management
- PCIF/1000 for interfacing with programmable controllers

- On-line system generation permits generation of new system configurations concurrently with other system activities
- Boot loaders support boot-up from:
 - CS/80 disc drive or its integral cartridge tape
 - A magnetic tape unit
 - An adjacent HP 1000 computer system in a DS/1000-IV Distributed Systems Network
 - PROM Storage Module
- Remote loading and diagnosis for programming and operation of systems at remote sites
- Front-to-rear air flow through cabinet maximizes system cooling efficiency and equipment reliability

- Complies with UL, CSA, and IEC-380 safety standards and with FCC Class A and VDE Level A EMI regulations

Computer description and specifications

For functional description of the Model 26, 27, and 29 computers, memory systems, input/output system, software and diagnostic support, compatibility, and A600+, A700, and A900 specifications, see the A-Series Computer Design and Specifications data sheet on page 1.

Memory Size and Available Card Cage Slots

See Tables 1 through 3.

Table 1. HP 1000 Model 26 System Memory Size and Available Card Cage Slots

| MEM SIZE (Mb) | FOR ECC MEMORY | | | | | | FOR PARTY MEMORY | | | | | | |
|------------------|-------------------------------|------------------|------------------|------------------|------------------|-----------------|-----------------------|------------------|------------------|------------------|-----------------|-----|-----------------------|
| | ORDER 2196C/D OPTION 014 AND: | | | | | | AVAIL CARD CAGE SLOTS | ORDER: | | | | | AVAIL CARD CAGE SLOTS |
| | MEMORY CONTROLLER | | MEMORY ARRAYS | | | AND ARRAY CONN. | | MEMORY ARRAYS | | | AND ARRAY CONN. | | |
| | 12110A 512 kb | 12110B 1.0 Mb | 12111A 512 kb | 12111B 1.0 Mb | 12111C 2.0 Mb | | | 12103A 128 kb | 12103C 512 kb | 12103D 1.0 Mb | | | |
| 0.5 | 1 | 0 | 0 | 0 | 0 | None | 16 | 0 | 0 | 0 | None | 16 | |
| 1.0 | 0 | 1 | 0 | 0 | 0 | None | 16 | 0 | 1 | 0 | 12038A | 15 | |
| 1.5 | 0 | 1 | 1 | 0 | 0 | 12038A | 15 | 0 | 2 | 0 | 12038B | 14 | |
| 2.0 | 0 | 1 | 0 | 1 | 0 | 12038A | 15 | 0 | 1 | 1 | 12038B | 14 | |
| 2.5 | 0 | 1 | 1 | 1 | 0 | 12038B | 14 | 0 | 2 | 1 | 12038C | 13 | |
| 3.0 | 0 | 1 | 0 | 2 | 0 | 12038B | 14 | 0 | 1 | 2 | 12038C | 13 | |
| 3.5 | 0 | 1 | 1 | 2 | 0 | 12038C | 13 | 0 | 2 | 2 | 12038D | 12 | |
| 4.0 | 0 | 1 | 0 | 1 | 1 | 12038B | 14 | 0 | 1 | 3 | 12038D | 12 | |
| 5.0 | 0 | 1 | 0 | 2 | 1 | 12038C | 13 | n/s | n/s | n/s | n/s | n/s | |
| 6.0 | 0 | 1 | 0 | 1 | 2 | 12038C | 13 | n/s | n/s | n/s | n/s | n/s | |
| 7.0* | 0 | 1 | 0 | 2 | 2 | 12038D | 12 | n/s | n/s | n/s | n/s | n/s | |
| 8.0* | 0 | 1 | 0 | 1 | 3 | 12038D | 12 | n/s | n/s | n/s | n/s | n/s | |

n/s = not supported * = This memory size is not supportable with 12157A Battery Backup.

Table 2. HP 1000 Model 27 System Memory Size and Available Card Cage Slots

| MEMORY SIZE | FOR ECC MEMORY | | | | FOR PARITY MEMORY | | | | | | | |
|-------------|-------------------------------|------------------|------------------|-----------------|-----------------------|-------------------------------|------------------|------------------|------------------|-----------------|-----|-----------------------|
| | ORDER 2197C/D OPTION 014 AND: | | | | AVAIL CARD CAGE SLOTS | ORDER 2197C/D OPTION 014 AND: | | | | | | AVAIL CARD CAGE SLOTS |
| | MEMORY ARRAYS | | | AND ARRAY CONN. | | MEMORY ARRAYS | | | | AND ARRAY CONN. | | |
| | 12111A* 512 kb | 12111B 1.0 Mb | 12111C 2.0 Mb | | | 12103A 128 kb | 12103B 256 kb | 12103C 512 kb | 12103D 1.0 Mb | | | |
| 512 kb | 1 | 0 | 0 | 12038A | 13 | # | # | # | # | None | 13 | |
| 1.0 Mb | 0 | 1 | 0 | 12038A | 13 | 0 | 0 | 0 | 1 | 12038A | 13 | |
| 1.5 Mb | 1 | 1 | 0 | 12038B | 12 | 0 | 0 | 1 | 1 | 12038B | 12 | |
| 2.0 Mb | 0 | 0 | 1 | 12038A | 13 | 0 | 0 | 0 | 2 | 12038B | 12 | |
| 2.5 Mb | 1 | 0 | 1 | 12038B | 12 | 0 | 0 | 1 | 2 | 12038C | 11 | |
| 3.0 Mb | 0 | 1 | 1 | 12038B | 12 | 0 | 0 | 0 | 3 | 12038C | 11 | |
| 3.5 Mb | 1 | 1 | 1 | 12038C | 11 | 0 | 0 | 1 | 3 | 12038D | 10 | |
| 4.0 Mb | 0 | 0 | 2 | 12038B | 12 | 0 | 0 | 0 | 4 | 12038D | 10 | |
| 5.0 Mb | 0 | 1 | 2 | 12038C | 11 | n/s | n/s | n/s | n/s | n/s | n/s | |
| 6.0 Mb | 0 | 0 | 3 | 12038C | 11 | n/s | n/s | n/s | n/s | n/s | n/s | |
| 7.0 Mb | 0 | 1 | 3 | 12038D | 10 | n/s | n/s | n/s | n/s | n/s | n/s | |
| 8.0 Mb | 0 | 0 | 4 | 12038D | 10 | n/s | n/s | n/s | n/s | n/s | n/s | |

* The 12111A 512 kb ECC Memory Array Card is preferred, but 12104A 512 kb ECC Memory Array Card is also usable.

512 kb parity memory is standard in 2197C/D systems; for that reason, no entry is required here.

n/s = not supported

Table 3. HP 1000 Model 29 System Memory Size and Available Card Cage Slots

| MEMORY SIZE | ORDER 2199C/D OPTION 014 AND: | | | AVAILABLE CARD CAGE SLOTS |
|-------------|-------------------------------|------------------|---------------------|---------------------------|
| | MEMORY ARRAYS | | AND ARRAY CONNECTOR | |
| | 12220A 768 kb | 12221A 3.0 Mb | | |
| 0.75 Mb* | 1 Std | 0 | 12222A Std | 13 |
| 1.50 Mb | 2 | 0 | 12222B | 12 |
| 2.25 Mb | 3 | 0 | 12222C | 11 |
| 3.00 Mb | 0 | 1 | 12222A | 13 |
| 3.75 Mb | 1 | 1 | 12222B | 12 |
| 4.50 Mb | 2 | 1 | 12222C | 11 |
| 5.25 Mb | 3 | 1 | 12222D | 10 |
| 6.00 Mb | 0 | 2 | 12222B | 12 |
| 9.00 Mb | 0 | 3 | 12222C | 11 |
| 12.00 Mb | 0 | 4 | 12222D | 10 |

THE FOLLOWING MEMORY SIZES USE MORE THAN FOUR ARRAY CARDS AND ARE THEREFORE NOT SUPPORTABLE BY THE 12157A BATTERY BACKUP SYSTEM

| | | | | |
|----------|---|---|--------|---|
| 15.00 Mb | 0 | 5 | 12222E | 9 |
| 18.00 Mb | 0 | 6 | 12222F | 8 |
| 21.00 Mb | 0 | 7 | 12222G | 7 |

* This is the base ECC memory that is deleted by 2199C/D Option 014 to make way for ordering memory arrays and a connector that provide more memory.

Available HP-IB Capacity

The 12009A HP-IB interface included in Model 26, 27, and 29 systems can support up to four hard discs. Although the HP-IB interface can address up to a total of 14 devices, it is advisable to use a different HP-IB interface to connect non-disc devices to the system to assure optimum performance.

Compatible System Consoles and Discs

See Tables 4 and 5.

Table 4. Compatible System Consoles

| TERMINAL | USE ONE OF THESE 219xC/D CONNECT OPT. | | |
|---------------------------------------|---------------------------------------|-----|---------------------------|
| | 005 | 006 | 008 PLUS 12040B AND CABLE |
| HP 2392A Display Terminal | No | Yes | 40242M |
| HP 2623A Graphics Terminal | Yes | No | 13222N |
| HP 2624B Display Terminal | Yes | No | 13222N |
| HP 2625A Dual System Display Terminal | No | Yes | 40242M |
| HP 2626A Display Station | Yes | No | 13222N |
| HP 2627A Color Graphics Terminal | Yes | No | 13222N |
| HP 2628A Word Processing Terminal | No | Yes | 40242M |
| HP 45610A HP Multifunction Terminal | No | Yes | 40242M |

Table 5. Compatible Discs (at least one 79xxR or 793xH disc is required with 219xC/D)

| PRODUCT NUMBER | TYPE | DISC CAP. (Mb) | AVG TRANS RATE (kb/s) | AVG ACC TIME (ms) |
|------------------|--|----------------|-----------------------|-------------------|
| 7911R | Hard, fixed with CS/80 cartridge tape drive for loading & backup | 28.1 | 983 | 35 |
| 7912R | | 65.6 | 983 | 35 |
| 7914R | | 131.2 | 983 | 36 |
| 7914ST or 7914TD | Hard, fixed with 1600 bpi mag tape | 131.2 | 983 | 36 |
| 7933H# | Hard, fixed | 404.4 | 1000 | 32 |
| 7935H# | Hard, removable | 404.4 | 1000 | 32 |
| 9121D | Dual microfloppy | 0.540 | 17 | 415 |

* Average transfer rate is based on the minimum time required to transfer one track without overrun.

This disc requires a separate program/data entry device, such as a 797xA/E mag tape or 79xxR Tape Cartridge Subsystem.

Electrical specifications

AC Power Requirements of 219xC/D System Processor Unit

System Processor Unit and rack mounting disc line voltage and frequency:

| | Line Voltage | Line Freq. |
|----------------|---------------------------|------------|
| 219xC/D Std | 115V -25%/+20% (86-138V)* | 47.5-66 Hz |
| 219xC/D 015 | 230V -23%/+20% (178-276) | 47.5-66 Hz |
| 7911/2/4R Std | 120V -10%/+5% (108-126V) | 54 -66 Hz |
| 7911/2/4R Std+ | 100V -10%/+5% (90-105V)+ | 54 -66 Hz |
| 7911/2/4R 015 | 220V -10%/+5% (198-231V) | 47.5-55 Hz |
| 7911/2/4R 015# | 240V -10%/+5% (216-252V) | 47.5-55 Hz |
| 794xA Std | 115V -22%/+10% (90-132V) | 47.5-66 Hz |
| 794xA 015 | 230V -22%/+14% (180-264V) | 47.5-66 Hz |

* 219xC standard System Processor Unit requires split-phase input with the line voltage listed here applied to both phases.

+ 100V/60 Hz is provided by restrapping a 7911/2/4R Standard disc in the field

240V/50 Hz is provided by restrapping a 7911/2/4R Option 015 disc in the field

Maximum operating current: 16A per phase for 219xC, 16A for 219xD.

Power cable: The standard 219xD System Processor Unit (SPU) includes a 3 metre (10 foot) power cable with NEMA 5-20P power plug. No power cable is provided with the 219xC SPU or with the 219xD SPU ordered with option 015.

Power Requirements of Terminals and Other Peripherals

See the Power Requirements table on page 41.

DC Current Available and Required for I/O Interfaces and Accessories

The SPU power supply provides enough current for any combination of A-Series interfaces or other A-Series plug-ins that can be accommodated in the SPU card cage.

Environmental specifications

219xC/D Temperature

Operating (SPU and disc): 10° to 40°C (50° to 104°F).

Rate of change: < 10°C (18°F) per hour for 7911R, 7912R, or 7914R Disc.

Non-operating temperature: -40° to 60°C (-40° to 140°F).

Relative Humidity (SPU and 79xxR Disc)

20% to 80% non-condensing.

Altitude

Operating: To 4.6 km (15,000 ft).

Non-operating: To 15.3 km (50,000 ft).

Vibration and Shock

HP 219xC/D System Processor Units are type tested for normal shipping and handling shock and vibration (contact factory for review of any application that requires operation under continuous vibration).

Safety and EMI compliance

Safety Qualification

The Model 26, 27, and 29 Systems meet Underwriter's Laboratory (UL), Canadian Standards Association (CSA), and International Electrotechnical Commission (IEC) safety standards.

EMI Compliance

The Model 26, 27, and 29 Systems comply with Federal Communications Commission (FCC) Class A and Verband Deutscher Elektrotechniker (VDE) Level A regulations for Electro Magnetic Interference (EMI).

Physical characteristics

Dimensions in cm (and inches)

| | 219xC SPU | 219xD SPU |
|---------|--------------|-------------|
| Height: | 161.3 (63.4) | 72.0 (28.3) |
| Width: | 63.5 (25) | 63.5 (25) |
| Depth: | 81.3 (32) | 81.3 (32) |

Weight

219xC SPU only (without disc): 139.7 kg (307.5 lb).

219xD SPU only (without disc): 94.3 kg (207.5 lb).

7911/12R/14R Disc adds: 67.3 kg (148 lb).

794xA Disc plus 19500A Rack Kit adds: 11.3 kg (24.8 lb).

9144A Tape Cartridge Subsystem plus 19500A Rack Kit adds: 9.9 kg (22 lb).

219xC/D SPU Ventilation

For computer and rack-mounted system disc: Perforations in the 219xC/D cabinet facilitate front-to-rear ventilation provided by the fans in the computer and system disc. This maximizes cooling efficiency and equipment reliability.

For equipment in upper section of 219xC cabinet: Four fans at the top rear of the system cabinet draw in air through an air filter at the bottom rear of the upper section, providing a bottom-to-top airflow of approximately 11.3 cubic metres per minute (400 CFM). The actual value of air flow depends upon the configuration of equipment racked in the upper section of the cabinet.

Systems ordering information

NOTE: 219xC/D SPUs require a compatible terminal (not included) for operator communication and a 79xxR, 7914ST/TD, 793xH, or 794xA disc for operating system and program development support.

2196C HP 1000 Model 26 System Processor Unit

The 2196C System Processor Unit includes:

1. CPU and memory as follows:
 - a. 12102B Memory Controller Card with 512 kb parity memory.
 - b. 12105-60001 A600+ CPU Card, instruction set and VCP ROMs, and 12038A Memory frontplane connector.
2. Disc and terminal interfaces and cables as follows:
 - a. 12009A-D01 HP-IB Interface to Disc, including cable.
 - b. 12005B-010 Asynchronous Serial (terminal) Interface card.
3. 29431F 1.6m (63-in) system cabinet with 20-slot card cage, power supply, and space for 7911R/12R/14R or 794xA + 19500A disc in lower compartment, space for other equipment in upper compartment, power distribution module, and anti-tip feet.
4. Software and supporting documentation as follows:
 - a. RTE-A Master with VC+ enhancement for large-program support, RTE-A/VC+ Primary system, and 24612A and 24398B diagnostics, on user-specified media.
 - b. License to use RTE-A on one System.
 - c. RTE-A and diagnostics manuals (see RTE-A and diagnostics data sheets in the HP 1000 Software Data book for manuals furnished).
5. 02156-90002 HP 1000 A600+ Computer Installation and Service Manual.

6. 02156-90001 HP 1000 A600+ Computer Reference Manual.
7. 02196-90002 HP 1000 Model 26/27/29 Computer System Installation Manual.
8. 02103-90005 Computer I/C Interfacing Guide.
9. 12005-90002 HP 12005A/B Asynchronous Interface Reference Manual.
10. 12009-90001 HP 12009A HP-IB Interface Reference Manual.
11. 59310-90064 HP-IB User's Guide.
12. 02172-90009 System Support Log.
13. Site preparation consultation.
14. On-site installation assistance and checkout by a Hewlett-Packard service engineer, including integration and test with primary system.
15. 90-day on-site warranty.
16. Four 93285A Engineering Units incorporated in the SPU in the course of manufacturing by Hewlett-Packard.

2196D HP 1000 Model 26 System Processor Unit

The 2196D System Processor Unit (SPU) is similar to the 2196C SPU, but is housed in a 29429A 72 cm (28.3-inch) cabinet that does not have an upper compartment for other equipment. Standard 2196D includes 3m (10 ft) power cable with NEMA 5-20P plug.

2196C/D Options

NOTE: Must order one of system console connect options 005, 006, or 008 and media option 022 or 061.

- 005:** Provides 15m (49 ft) fiber optic cable connection to system console as specified in Table 4 on page 15 (excludes option 006 or 008).
- 006:** Provides 5m (16.4ft) electrical cable connection to system console as specified in Table 4 on page 15 (excludes option 005 or 008).
- 008:** Deletes 12005B interface and 12005-90002 manual to permit their replacement with a 12040B multiplexer and a connect cable as specified in Table 4 on page 15 for the various compatible terminals (excludes option 005 or 006).
- 014:** Deletes 12102B 512 kb parity memory controller, permitting its replacement with a 12110A 512 kb or 12110B 1 Mb ECC memory controller. (Must order 12110x ECC memory controller, and memory array cards and 12038x connector as appropriate; see Table 1 on page 14.)
- 015:** Operation from 220V ac power. Power options for system console, disc, and other peripherals must be ordered separately.
- 022:** Software on CS/80 cartridge tape for use with 791xR disc or 9144A Tape Cartridge Subsystem (excludes option 061).

- 050:** Magnetic tape trim. Provides large cutout in upper door of 2196C cabinet to accommodate a 7970E Mag tape unit.
- 053:** Lower door in 2196C without cutout for system that does not have 791xR disc with tape cartridge drive or 9144A Tape Cartridge Subsystem.
- 061:** Software on 1600 bpi mag tape (excludes option 022).
- 070:** Deletes cabinet from 2196C SPU to permit racking in cabinet of 7914ST or 7914TD Disc-Mag Tape Unit package and adds a second 12009A interface for connection to the Mag Tape Unit.

2197C HP 1000 Model 27 System Processor Unit

The 2197C System Processor Unit includes:

1. CPU and memory as follows:
 - a. 12103C 512 kb Memory array card.
 - b. 12038A Memory frontplane connector assembly.
 - c. A700 CPU, including 12152-60001 and 60051 processor cards, 12152-60052 memory controller, and instruction set and VCP PROMs.
 - d. 12156A Hardware Floating Point Processor Card with Scientific Instruction Set and Vector Instruction Set firmware and floating point front plane connector.
- 2 through 4. Same as for 2196C, above.
5. 02137-90002 HP 1000 A700 Computer Installation and Service Manual.
6. 02137-90001 HP 1000 A700 Computer Reference Manual.
- 7 through 16. Same as for 2196C, above.

2197D HP 1000 Model 27 System Processor Unit

The 2197D System Processor Unit (SPU) is similar to the 2197C SPU, but is housed in a 29429A 72 cm (28.3-inch) cabinet that does not have an upper compartment for other equipment. Standard 2197D includes 3m (10 ft) power cable with NEMA 5-20P plug.

2197C/D Options

NOTE: Must order one of system console connect options 005, 006, or 008 and media option 022 or 061.

- 005 through 008:** Same as for 2196C/D, above.
- 014:** Deletes standard 512 kb parity memory array card and front plane connector, permitting their replacement with other memory array cards. (Must order other A700 compatible memory card(s) and appropriate 12038x connector; see Table 2 on page 14).
- 015, 022, 050, 053, 061, and 070:** Same as for 2196C/D, above.

2199C HP 1000 Model 29 System Processor Unit

The 2199C System Processor Unit includes:

1. CPU and memory as follows:
 - a. 12201A Sequencer card with ROMs.
 - b. 12202A Data Path card with Floating Point Processors.
 - c. 12203A Cache Control card with VCP ROMs.
 - d. 12204A Memory Controller card.
 - e. 12220A 768 kb ECC Memory Array card.
 - f. 12222A Memory Array Connector.
- 2 through 4. Same as for 2196C, above.
5. 02139-90002 HP 1000 A900 Computer Installation and Service Manual.
6. 02139-90001 HP 1000 A900 Computer Reference Manual.
- 7 through 16. Same as for 2196C, above.

2199D HP 1000 Model 29 System Processor Unit

The 2199D System Processor Unit (SPU) is similar to the 2199C SPU, but is housed in a 29429A 72 cm (28.3-inch) cabinet that does not have an upper compartment for other equipment. Standard 2199D includes 3m (10 ft) power cable with NEMA 5-20P plug.

2199C/D Options

NOTE: Must order one of system console connect options 005, 006, or 008 and media option 022 or 061.

005 through 008: Same as for 2196C/D, above.

014: Deletes standard 768 kb ECC memory array card and front plane connector, permitting their replacement with other memory array cards. (Must order other A900 compatible memory card(s) and appropriate 12222x array connector; see Table 3 on page 15.)

015, 022, 050, 053, 061, and 070: Same as for 2196C/D, above.

Accessories ordering information

Optional software

See Extensive software support on page 4.

Memory Cards and Array Connectors

See Table 1, 2, or 3 for the memory cards and array connector which are required to provide the desired ECC or parity memory in the Model 26, 27, or 29 System.

Plug-in Hardware Accessories

12157A Battery Backup System using sealed lead-acid batteries (provides 15 to 90 minutes of sustaining power for up to four memory array cards), depending upon the system configuration, state of charge, and temperature;

additional hold-up time can be achieved by connecting an external battery. **NOTE:** This accessory is installed in the computer power supply and does NOT use a card cage slot.

12158A 25 kHz Power Module (provides up to 50W of 39V rms ac power (two phases) at 25 kHz, which is filtered from the output of the power supply switcher). **NOTE:** This accessory is installed in the computer power supply and does NOT use a card cage slot.

User Control Store Cards

12153A A700 Writable Control Store card (provides 4k words of control store space).

12155A A700 PROM Control Store card (provides mounting for up to 8k words of PROMs).

12205A A900 Control Store Board (provides 4k words of writable control store and mounting space for 2k words of 2k control store PROMs).

Interfaces

The HP 219xC/D SPU can use all of the interfaces listed in the A-Series Interfaces Technical Data book (5953-8760 or later version) but the following interfaces will require the 12158A 25 kHz Power Module:

| | |
|--------|---|
| 12060B | High-Level Analog Input Card |
| 12061A | Expansion Multiplexer Card |
| 12062A | Analog Output Card |
| 12063A | 26-Input/16-Output Digital I/O Card |
| 37203L | HP-IB Extender Card using coaxial cable communication. (The 37203L Option 001 HP-IB Extender Card does not require 25 kHz power for fiber optic cable communication.) |

Peripheral Devices

See the HP 1000 Peripherals Selection Guide.

Additional Documentation Available

For A600+: 02156-90003 HP 1000 A600 Computer Engineering and Reference Documentation

For A700: 02137-90005 HP 1000 A700 Computer Engineering and Reference Documentation

For A900: 02139-90003 HP 1000 A900 Computer Engineering and Reference Documentation.



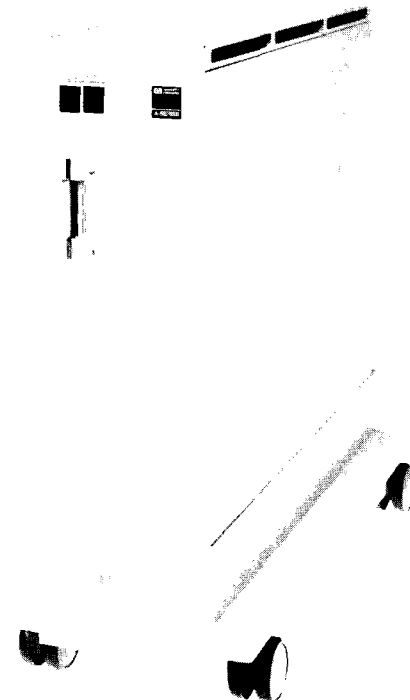
HP 1000 A-Series Computer Systems

product numbers 2436A, 2437A,
2439A, 2486A, 2487A, and 2489A

The Micro/1000 Computer Systems offer a choice of HP's powerful A600+, A700, and A900 processors in a rugged, compact, versatile Micro/1000 package. The Micro/1000 package can be mounted in a standard 19-inch EIA rack cabinet or in a convenient vertical desk-side or under-table floor mounting accessory on casters that make it easy to move to wherever it is needed. The Micro/1000 package includes cabinet, power supply, 12 or 14 card cage slots* for CPU, memory, control store, and I/O cards, and dedicated slots for 25 kHz sine wave and battery backup cards. The Micro/1000 package can also accommodate integrated 14.5 megabyte fixed and 270 kilobyte microfloppy discs. Micro/1000 packaged products are summarized in Table 1, below.

Features

- Low-cost, rugged, compact EIA 19-inch standard rack mounting or vertical floor mount package with integrated 14.5 Mb fixed and 270 kb microfloppy discs (or with CS/80 disc) that serves as a building block for OEMs and end users designing their own A-Series based products



*Number of card cage slots available depends upon use of battery backup and power used by installed cards.

Table 1. Micro/1000 Products Summary

| COMPUTER TYPE | SYSTEM PROCESSOR UNITS (SPUs) (include CPU, memory, disc and system console interfaces, and RTE-A operating system; requires system console terminal and integrated 14.5 Mb fixed and 270 kb microfloppy discs (Option 111) or CS/80 disc). | | | OEM COMPONENTS (Include only CPU and memory) | | |
|-------------------|---|--------------------------|-----------------|---|--------------------------|--------------------|
| | A600+ | A700 | A900 | A600+ | A700 | A900 |
| PRODUCT NO. | 2486A | 2487A | 2489A | 2436A | 2437A | 2439A |
| NAME | Micro 26 System | Micro 27 System | Micro 29 System | Micro 26 Component | Micro 27 Component | Micro 29 Component |
| BASE MEMORY | 512 kb parity | 512 kb parity | 768 kb ECC | 128 kb parity | 128 kb parity | 768 kb ECC |
| MAX. MEMORY | 4 Mb parity or 8 Mb ECC | 4 Mb parity or 8 Mb ECC* | 6 Mb ECC | 4 Mb parity or 8 Mb ECC | 4 Mb parity or 8 Mb ECC* | 6 Mb ECC |
| SERVICES INCLUDED | Site Preparation Consultation, On-Site Installation Assistance, and 90-day On-Site Warranty. | | | Services at left are not included and must be ordered separately. | | |

* The Option 001 Floating Point Processor card and/or each control store card in 2437A or 2487A decreases maximum parity memory capacity by 1 Mb, maximum ECC memory capacity by 2 Mb.

- 12 or 14 card cage slots depending on whether battery backup is installed plus dedicated slots for:
 - Plug-in 25 kHz sine wave card
 - Plug-in battery backup card
- Dual-speed fans for low acoustic noise level
- Supports A600+, A700 and A900 computers and all A-Series interfaces, including those that require 25 kHz power when the optional 12159A 25 kHz Sine Wave card is installed
- Built-in dynamic mapping system, memory protect, time base generator, and self test
- Power fail detection and auto restart with optional 12154A Battery Backup Card
- Boot loaders support boot-up from:
 - Integrated or standalone microfloppy disc or standalone CS/80 or 9133XV disc
 - A magnetic tape unit
 - An adjacent HP 1000 computer system in a DS/1000-IV Distributed Systems Network
 - PROM Storage Module
- Complies with UL, CSA, and IEC-380 safety standards and with FCC Class A and VDE Level A EMI regulations
- Extensive software support, including:
 - Real-time multiprogramming executive operating system
 - FORTRAN 77, Pascal, BASIC, and Macroassembler programming plus interactive screen editor, and Symbolic Debug/1000 for program development
 - Image/1000 Data Base Management software
 - Graphics/1000-II software
 - DS/1000-IV Distributed Systems Networking software
 - Three packages for communication with IBM or IBM plug-compatible systems
 - PMC/1000 for process monitoring and control
 - QDM/1000 for quality data management
 - PCIF/1000 for interfacing with programmable controllers
- Large program and data capacity support with:
 - Optional VC+ capability for programs to 7.75 megabytes
 - Virtual memory for data, divided between main memory and disc, supports transparent processing of data arrays up to 128 megabytes
 - Multiple sharable Extended Memory Areas (EMAs) for data arrays up to 2 megabytes resident in main memory. Up to 15 EMAs are supportable, each sharable by as many as 63 programs
- Instruction and program compatibility with other members of the HP 1000 family protects software investment of current OEMs and end users and gives users access to a broad base of proven software
- On-line system generation permits generation of new system configurations concurrently with other system activities

- Remote loading and diagnosis for programming and operation of systems at remote sites
- Mail-in board exchange and various service agreements supported from local HP sales offices provide a wide choice of support alternatives

Computer description and specifications

For functional description of the Micro 26, Micro 27, and Micro 29 computers, memory systems, input/output system, software and diagnostic support, compatibility with other HP 1000 Computers, and A600+, A700, and A900 specifications, see page 1.

System configuration specifications

How Battery Backup Affects Card Cage Capacity

The battery backup card extends up from its dedicated card cage slot 16 into slots 14 and 15, making them unusable for I/O cards when the battery backup card is installed. If the included voltage jumper is installed in slot 16 instead of the battery backup card, slots 14 and 15 may be usable for I/O cards, provided that total power used by all cards does not exceed power supply capacity.

Micro 26 Configuration Examples

Minimum memory configuration, looking into card cage:

| | | | |
|----|------------------------|---|-------------------------|
| 9 | Available for I/O Card | 1 | 512 kb Parity Mem Ctrlr |
| 10 | Available for I/O Card | 2 | A600+ CPU Card |
| 11 | Available for I/O Card | 3 | 12009A/12022A Disc I/O |
| 12 | Available for I/O Card | 4 | 12005B Async Term. I/O |
| 13 | Available for I/O Card | 5 | Available for I/O Card |
| 14 | Batt Backup or I/O Cd | 6 | Available for I/O Card |
| 15 | Batt Backup or I/O Cd | 7 | Available for I/O Card |
| 16 | For Battery Backup Cd | 8 | For 25 kHz Sine Wave Cd |

Maximum memory configuration with 8 Mb of ECC memory, looking into card cage:

| | | | |
|----|------------------------|---|-------------------------|
| 9 | 12005B Async Term I/O | 1 | 12111C 2 Mb ECC Memory |
| 10 | Available for I/O Card | 2 | 12111C 2 Mb ECC Memory |
| 11 | Available for I/O Card | 3 | 12111C 2 Mb ECC Memory |
| 12 | Available for I/O Card | 4 | 12111B 1 Mb ECC Memory |
| 13 | Available for I/O Card | 5 | 12110B 1 Mb ECC Mem Ctl |
| 14 | Batt Backup or I/O Cd | 6 | A600+ CPU Card |
| 15 | Batt Backup or I/O Cd | 7 | 12009A/12022A Disc I/O |
| 16 | For Battery Backup Cd | 8 | For 25 kHz Sine Wave Cd |

Micro 27 Configuration Examples

Minimum configuration, looking into card cage:

| | | | |
|----|------------------------|---|-------------------------|
| 9 | Available for I/O Card | 1 | 12103C 512 kb Par Mem |
| 10 | Available for I/O Card | 2 | Memory Control Card |
| 11 | Available for I/O Card | 3 | Upper CPU Card |
| 12 | Available for I/O Card | 4 | Lower CPU Card |
| 13 | Available for I/O Card | 5 | 12009A/12022A Disc I/O |
| 14 | Batt Backup or I/O Cd | 6 | 12005B Async Term. I/O |
| 15 | Batt Backup or I/O Cd | 7 | Available for I/O Card |
| 16 | For Battery Backup Cd | 8 | For 25 kHz Sine Wave Cd |

Configuration with floating point processor, looking into card cage:

| | | | |
|----|------------------------|---|-------------------------|
| 9 | Available for I/O Card | 1 | 12111C 2 Mb ECC Memory |
| 10 | Available for I/O Card | 2 | Memory Control Card |
| 11 | Available for I/O Card | 3 | Upper CPU Card |
| 12 | Available for I/O Card | 4 | Floating Pt Proc Card |
| 13 | Available for I/O Card | 5 | Lower CPU Card |
| 14 | Batt Backup or I/O Cd | 6 | 12009A/12022A Disc I/O |
| 15 | Batt Backup or I/O Cd | 7 | 12005B Async Term. I/O |
| 16 | For Battery Backup Cd | 8 | For 25 kHz Sine Wave Cd |

Maximum configuration with floating point processor and writable control store (WCS), looking into card cage:

| | | | |
|----|------------------------|---|-------------------------|
| 9 | 12009A/12022A Disc I/O | 1 | 12111C 2 Mb ECC Memory |
| 10 | 12005B Async Term I/O | 2 | 12111C 2 Mb ECC Memory |
| 11 | Available for I/O Card | 3 | Memory Control Card |
| 12 | Available for I/O Card | 4 | Upper CPU Card |
| 13 | Available for I/O Card | 5 | Floating Pt Proc Card |
| 14 | Batt Backup or I/O Cd | 6 | Lower CPU Card |
| 15 | Batt Backup or I/O Cd | 7 | 12153A WCS Card |
| 16 | For Battery Backup Cd | 8 | For 25 kHz Sine Wave Cd |

Maximum memory configuration with 8 Mb of ECC memory, looking into card cage:

| | | | |
|----|------------------------|---|-------------------------|
| 9 | 12009A/12022A Disc I/O | 1 | 12111C 2 Mb ECC Memory |
| 10 | 12005B Async Term I/O | 2 | 12111C 2 Mb ECC Memory |
| 11 | Available for I/O Card | 3 | 12111C 2 Mb ECC Memory |
| 12 | Available for I/O Card | 4 | 12111C 2 Mb ECC Memory |
| 13 | Available for I/O Card | 5 | Memory Control Card |
| 14 | Batt Backup or I/O Cd | 6 | Upper CPU Card |
| 15 | Batt Backup or I/O Cd | 7 | Lower CPU Card |
| 16 | For Battery Backup Cd | 8 | For 25 kHz Sine Wave Cd |

Micro 29 Configuration Examples

Minimum configuration, looking into card cage:

| | | | |
|----|------------------------|---|-------------------------|
| 9 | Available for I/O Card | 1 | 12009A/12022A Disc I/O |
| 10 | Available for I/O Card | 2 | 12201A Sequencer Card |
| 11 | Available for I/O Card | 3 | 12202A Data Path Card |
| 12 | Available for I/O Card | 4 | 12203A Cache Control |
| 13 | Available for I/O Card | 5 | 12204A Memory Control |
| 14 | Batt Backup or I/O Cd | 6 | 12220A 768 kb ECC Mem |
| 15 | Batt Backup or I/O Cd | 7 | 12005B Async Term I/O |
| 16 | For Battery Backup Cd | 8 | For 25 kHz Sine Wave Cd |

Maximum configuration with control store and 6 Mb of ECC memory, looking into card cage:

| | | | |
|----|------------------------|---|-------------------------|
| 9 | 12009A/12022A Disc I/O | 1 | 12205A Control Store |
| 10 | 12005B Async Term I/O | 2 | 12201A Sequencer Card |
| 11 | Available for I/O Card | 3 | 12202A Data Path Card |
| 12 | Available for I/O Card | 4 | 12203A Cache Control |
| 13 | Available for I/O Card | 5 | 12204A Memory Control |
| 14 | Batt Backup or I/O Cd | 6 | 12221A 3 Mb ECC Memory |
| 15 | Batt Backup or I/O Cd | 7 | 12221A 3 Mb ECC Memory |
| 16 | For Battery Backup Cd | 8 | For 25 kHz Sine Wave Cd |

Compatible System Consoles and Discs

See Tables 2 and 3.

Table 2. Compatible System Consoles and 248xA Connect Options

| TERMINAL | USE ONE OF THESE 248xA CONNECT OPTIONS | | |
|---------------------------------------|--|-----|---------------------------|
| | 005 | 006 | 008 PLUS 12040B AND CABLE |
| HP 2392A Display Terminal | No | Yes | 40242M |
| HP 2623A Graphics Terminal | Yes | No | 13222N |
| HP 2624B Display Terminal | Yes | No | 13222N |
| HP 2625A Dual System Display Terminal | No | Yes | 40242M |
| HP 2626A Display Station | Yes | No | 13222N |
| HP 2627A Color Graphics Terminal | Yes | No | 13222N |
| HP 2628A Word Processing Terminal | No | Yes | 40242M |
| HP 45610A HP Multifunction Terminal | No | Yes | 40242M |

Table 3. Compatible Discs (248xA Option 111 or one 79xxP/R or 793xH disc is required for 248xA SPU)

| PRODUCT NUMBER | TYPE | DISC CAP. (Mb) | AVG TRANS RATE (kb/s) | AVG ACC TIME (ms) |
|------------------|------------------------------------|----------------|-----------------------|-------------------|
| 248xA+111 | Hard fixed disc & microfloppy disc | 14.5 0.27 | 230 17 | 85 430 |
| 7911P/R | Hard, fixed with CS/80 cartridge | 28.1 | 983 | 35 |
| 7912P/R | tape drive for loading & backup | 65.6 | 983 | 35 |
| 7914P/R | | 131.2 | 983 | 36 |
| 7914ST or 7914TD | Hard, fixed with 1600 bpi mag tape | 131.2 | 983 | 36 |
| 7933H# | Hard, fixed | 404.4 | 1000 | 32 |
| 7935H# | Hard, removable | 404.4 | 1000 | 32 |
| 9121D | Dual microfloppy | 0.540 | 17 | 415 |

* Average transfer rate is based on the minimum time required to transfer one track without overrun.

This disc requires a separate program/data entry device, such as a 797xA/E mag tape or 79xxP/R tape cartridge subsystem.

Electrical specifications

AC Power Requirements

Micro/1000 Line voltage and frequency:

115V -25%/+20% (86-138V), 47.5-66 Hz (std)
230V -23%/+20% (178-276V), 47.5-66 Hz (Opt 015).

Operating current: 6A, max. in 115V configuration, 3A, max. in 230V configuration.

Power cable: The standard 243xA or 248xA Micro/1000 unit includes a 2 metre (6.5 ft) power cable with NEMA 5-15P power plug. Units ordered with Option 015 are provided with a power cable appropriate for the destination country.

Power Requirements of Terminals and Other Peripherals

See the Power Requirements table on page 41.

DC Current Available (+) and Required (-) for I/O Interfaces and Accessories

See Table on page 42.

Environmental specifications

Temperature

Operating for base Micro/1000: 0° to 55°C (32° to 131°F) to 3048 metres (10,000 ft). Maximum temperature is linearly derated 2°C (3.6°F) for each 304.8m (1,000 ft) increase of altitude. Resulting temperature range is 0° to 45°C (32° to 113°F) at 4572 metres (15,000 ft).

Option 111 integral disc: 5° to 45°C (40° to 115°F); maximum rate of change < 10°C (18°F) per hour.

Non-operating: -40° to 60°C (-40° to 140°F)(maximum temperature with Option 111 integral discs is 60°C (140°F)).

Relative Humidity

20% to 80% non-condensing (5% to 95% without Option 111 discs).

Altitude

Operating: To 4.6 km (15,000 ft).

Non-operating: To 15.3 km (50,000 ft).

Vibration and Shock

HP 243xA and 248xA Micro/1000 units are type tested for normal shipping handling shock and vibration (contact factory for review of any application that requires operation under continuous vibration).

Safety and EMI compliance

Safety Qualification

HP 243xA and 248xA Micro/1000 units meet all applicable Underwriter's Laboratory (UL), Canadian Standards Association (CSA), and International Electrotechnical Commission (IEC) safety standards.

EMI Compliance

HP 243xA and 248xA Micro/1000 units comply with Federal Communications Commission (FCC) Class A and Verband Deutscher Elektrotechniker (VDE) Level A regulations for Electromagnetic Interference (EMI).

Physical characteristics

Package

Standard 19-inch EIA rack mountable package.

Dimensions in cm (and inches)

Rack mounting Micro/1000 Package: 17.8 cm (7 in.) high x 48.3 cm (19 in.) wide x 64.8 cm (25.5 in.) deep.

Micro/1000 Package in 40025A Vertical Floor Mount: 67.3 cm (26.5 in.) high x 34.7 cm (13.6 in.) wide x 64.8 cm (25.5 in.) deep.

Weight

2436A or 2486A without option 111: 16.3 kg (36 lb).

2437A or 2487A without option 111: 16.8 kg (37 lb).

2439A or 2489A without option 111: 18.1 kg (40 lb).

Option 111 Integrated discs add: 2.27 kg (5 lb).

40025A Vertical Floor Mount adds: 5.68 kg (12.5 lb).

Cooling

Four fans provide left-to-right airflow through the 243xA/248xA card cage and for the 243xA/248xA power supply and integrated discs. Dual speed feature allows fans to operate at lower speed and reduced noise level.

Micro/1000 Systems ordering information

NOTE: 248xA SPUs require a compatible terminal (not included) for operator communication and Option 111 integrated discs or 79xxP/R, 7914ST/TD, 793xH, or 794xA disc for operating system and program development support.

2486A Micro 26 System Processor Unit

The 2486A System Processor Unit includes:

1. CPU and memory as follows:
 - a. 12102B Memory Controller Card with 512 kb memory.
 - b. 12105A 60001 A600+ CPU Card, instruction set and VCP ROMs, and 12038A Memory frontplane connector.
2. Micro/1000 Package with power supply and 12 or 14 card cage slots* for CPU, memory, and I/O cards, dedicated slots for 25 kHz sine wave and battery back-up cards, voltage jumper card, and power cable.
3. Disc and terminal interfaces and cables as follows:
 - a. 12009A+D01 HP-IB Interface to disc, including cable.
 - b. 12005B+010 Asynchronous Serial (terminal) Interface card.
4. Software and supporting documentation as follows:
 - a. RTE-A Master, RTE-A Primary system, and 24612A and 24398B diagnostics, on option-specified media.
 - b. License to use RTE-A on one system.
 - c. RTE-A and diagnostics manuals (see RTE-A and Diagnostics data sheets in the HP 1000 Software Data book for manuals furnished).
5. 02430-90001 Micro/1000 Computer System Installation Manual.
6. 02156-90001 HP 1000 A600 Computer Reference Manual.
7. 02103-90005 Computer I/O Interfacing Guide.
8. 12005-90002 HP 12005A/B Asynchronous Interface Reference Manual.
9. 12009-90001 HP 12009A HP-IB Interface Reference Manual.
10. Site preparation consultation.
11. On-site installation assistance and checkout by a Hewlett-Packard service engineer, including integration and test with primary system.
12. 90-day on-site warranty.
13. Four 93285A Engineering Units incorporated in the SPU in the course of manufacturing by Hewlett-Packard.

2486A Options

NOTE: Must order one of system console connect options 005, 006, or 008 and one of media options 022, 044, or 061.

- 005:** Provides 15m (49 ft) fiber optic cable connection to system console as specified in Table 2 on page 21 (excludes option 006 or 008).
- 006:** Provides 5m (16.4 ft) electrical cable connection to system console as specified in Table 2 on page 21 (excludes option 005 or 008).
- 008:** Deletes 12005B interface and 12005-90002 manual to permit their replacement with a 12040B multiplexer and a connect cable as specified in Table 2 on page 21 for the various compatible terminals (excludes option 005 or 006).

- 014:** Deletes 12102B 512 kb parity memory controller, permitting its replacement with a 12110A 512 kb or 12110B 1 Mb ECC memory controller. (Must order 12110x ECC memory controller, and memory array cards and 12038x connector as appropriate; see Table 4 on page 25.)
- 015:** Operation from 220V ac power. Power options for system console, disc, and other peripherals must be ordered separately.
- 022:** Software on CS/80 cartridge tape for use with 791xP/R disc or 9144A Tape Cartridge Subsystem (excludes option 044 or 061).
- 044:** Software on Microfloppy discs (excludes option 022 or 061).
- 061:** Software on 1600 bpi mag tape (excludes option 022 or 044).
- 111:** Provides integrated 14.5 Mb fixed and 270 kb microfloppy discs, replaces 12009A+D01 interface and 12009-90001 manual with 12022A disc interface.

2487A Micro 27 System Processor Unit

The 2487A System Processor Unit includes:

1. CPU and memory as follows:
 - a. 12103C 512 kb Memory array card.
 - b. 12038A Memory frontplane connector assembly.
 - c. A700 CPU, including 12152-60001 and 60051 processor cards, 12152-60052 memory controller, and instruction set and VCP PROMs.
 - d. 12160A Frontplane connector assembly.
- 2 through 5. Same as 2 through 5 for 2486A above.
6. 02137-90001 HP 1000 A700 Computer Reference Manual.
- 7 through 13. Same as 7 through 13 for 2486A, above.

2487A Options

NOTE: Must order one of system console connect options 005, 006, or 008 and one of media options 022, 044, or 061.

- 001:** Adds 12156A Floating Point Processor Card with Scientific and Vector Instruction Sets (including the 12156-90001 A700 Floating Point Processor Installation Manual) and replaces 12160A two-connector frontplane connector assembly with a 12156-60002 three-connector frontplane assembly (uses one card cage slot).

005, 006, and 008: Same as for 2486A, above.

- 014:** Deletes standard 512 kb parity memory array card and front plane connector, permitting their replacement with other A700 compatible memory card(s) and appropriate 12038x connector; see Table 5 on page 26.

015, 022, 044, 061, and 111: Same as for 2486A, above.

*Number of available card cage slots depends upon use of battery backup and power used by installed cards.

2489A Micro 29 System Processor Unit

The 2489A System Processor Unit includes:

1. A900 CPU and memory as follows:
 - a. 12201A Sequencer card with ROMs.
 - b. 12202A Data Path card with Floating Point Processors.
 - c. 12203A Cache Control Card with VCP ROMs.
 - d. 12204A Memory Controller card.
 - e. 12220A 768 kb ECC Memory Array card.
 - f. 12222A Memory Array Connector.
 2. 2430B Micro/1000 Package with power supply and 12 or 14 card cage slots* for CPU, memory, and I/O cards, dedicated slots for 25 kHz sine wave and battery backup cards, voltage jumper card, and power cable.
- 3 through 5. Same as 3 through 5 for 2486A, above.
6. 02139-90001 HP 1000 A900 Computer Reference Manual.
- 7 through 13. Same as 7 through 13 for 2486A, above.

2489A Options

NOTE: Must order system console connect option 005 or 006 and one of media options 022, 044, or 061.

005 and 006: Same as for 2486A, above.

014: Deletes standard 768 kb ECC memory array card and front plane connector, permitting their replacement with other memory array cards. (Must order other A900 compatible memory card(s) and appropriate 12222x array connector; see Table 6 on page 26.

015, 022, 044, 061, and 111: Same as for 2486A, above.

Micro/1000 Components ordering information

NOTE: 243xA Micro/1000 components require the RTE-A operating system and a 12005B terminal interface or 12040B Multiplexer (except on 2439A), cable, and a compatible terminal or a DS/1000-IV interface linked to another HP 1000 Computer System for operation.

2436A Micro 26 Component

The 2436A Micro 26 Component includes:

1. CPU and memory as follows:
 - a. 12102A Memory Controller Card with 128 kb memory.
 - b. 12105-60001 A600+ CPU Card, instruction set and VCP ROMs, and 12038A Memory front plane connector.
2. 2430A Micro/1000 Package with power supply and 12 or 14 card cage slots* available for CPU, memory, and I/O cards, dedicated slots for 25 kHz sine wave and battery battery backup cards, voltage jumper card, and power cable.

3. 02430-90001 Micro/1000 Computer System Installation Manual.
4. 02103-90005 Computer I/O Interfacing Guide.
5. 02156-90001 HP 1000 A600+ Computer Reference Manual.

2436E Micro 26 Execute-Only Component

The 2436E Micro 26 Execute-Only Component includes:

1. 2436A Micro 26 Component, but with 12102B 512 kb Memory Controller instead of 12102A 128 kb Memory Controller.
2. 92077E+600 Right-to-Execute RTE-A on one system.

2436A/E Options

014: Deletes standard parity memory controller, permitting its replacement with a different memory controller. (Must order memory controller, memory array cards, and 12038x connector as appropriate; see Table 4 on page 25.)

015: Operation from 230V ac power. Power options for peripheral devices must be ordered separately.

111: Adds integrated 14.5 Mb fixed and 270 kb microfloppy discs and 12022A disc interface.

2437A Micro 27 Component

The 2437A Micro 27 Component includes:

1. CPU and memory as follows:
 - a. 12103A 128 kb Memory array card.
 - b. 12038A Memory frontplane connector assembly.
 - c. A700 CPU, including 12152-60001 and 60051 processor cards, 12152-60052 memory controller, and instruction set and VCP PROMs.
 - d. 12160A Frontplane connector assembly.
- 2 through 4. Same as 2 through 4 for 2436A, above.
5. 02137-90001 HP 1000 A700 Computer Reference Manual.

2437A Options

001: Adds 12156A Floating Point Processor Card with Scientific and Vector Instruction Sets (including the 12156-90001 A700 Floating Point Processor Installation Manual) and replaces 12160A two-connector Frontplane connector assembly with a 12156-60002 three-connector frontplane assembly (uses one card cage slot).

014: Deletes standard 128 kb parity memory array card and front plane connector, permitting their replacement with other A700 memory card(s) and appropriate 12038x connector; see Table 5 on page 26.

015 and 111: Same as for 2436A/E, above.

*Number of available card cage slots depends upon use of battery backup and power used by installed cards.

2439A Micro 29 Component

The 2439A Micro 29 Component includes:

1. A900 CPU and memory as follows:
 - a. 12201A Sequencer card with ROMs.
 - b. 12202A Data Path card with Floating Point Processors.
 - c. 12203A Cache Control card with VCP ROMs.
 - d. 12204A Memory Controller card.
 - e. 12220A 768 kb ECC Memory Array card.
 - f. 12222A Memory frontplane connector assembly.
2. Micro/1000 Package with power supply and 12 or 14 card cage slots* for CPU, memory, and I/O cards, dedicated slots for 25 kHz sine wave and battery back-up cards, voltage jumper card, and power cable.
- 3 and 4. Same as 3 and 4 for 2436A, above.
6. 02139-90001 HP 1000 A900 Computer Reference Manual.

2439A Options

014: Deletes standard 768 kb ECC memory array card and front plane connector, permitting their replacement with other memory array cards. (Must order other A900 memory card(s) and appropriate 12222x array connector; see Table 6 on page 26.)

015 and 111: Same as for 2436A/E, above.

Accessories ordering information

40025A Vertical Floor Mount

The 40025A Vertical Floor Mount is a convenient base on casters for compact vertical desk-side or under-table mounting and easy mobility of Micro 26, 27, and 29 Systems or components that are not to be rack mounted.

Optional Software

See page 4 of this Data book.

User Control Store Cards

12153A A700 Writable Control Store card (provides 4k words of control store capacity).

12155A A700 PROM Control Store card (provides mounting for up to 8k words of PROMs).

12205A A900 Control Store Board (provides 4k words of writable control store and mounting space for 2k words of 2k control store PROMs).

Plug-in Hardware Accessories

12154A Battery Backup Card (provides 45 to 210 minutes of sustaining power for up to four memory array cards, depending upon the system configuration, state of charge, and temperature; additional hold-up time can be achieved by connecting an external battery).

12159A 25 kHz Sine Wave Card (provides up to 30W of 39V rms ac power (two phases) at 25 kHz, which is filtered from the output of the power supply switcher).

Memory Expansion and Array Connectors

See Tables 4 through 6.

*Number of available card cage slots depends upon use of battery backup and power used by installed cards.

Table 4. HP 1000 Micro 26 Memory Size and Available Card Cage Slots

| MEM SIZE (Mb) | FOR ECC MEMORY | | | | | | FOR PARITY MEMORY | | | | | |
|------------------|---|------------------|------------------|------------------|------------------|-----------------|----------------------------------|--|------------------|------------------|-----------------|----------------------------------|
| | ORDER 2436A/2436E/2486A OPTION 014 AND: | | | | | | CARD CAGE SLOTS AVAIL. IN 2486A# | ORDER 2436A OPTION 014 (NOT REQUIRED WITH 2436E OR 2486A) AND: | | | | CARD CAGE SLOTS AVAIL. IN 2486A# |
| | MEMORY CONTROLLER | | MEMORY ARRAYS | | | AND ARRAY CONN. | | MEMORY CTRLR | MEMORY ARRAYS | | AND ARRAY CONN. | |
| | 12110A 512 kb | 12110B 1.0 Mb | 12111A 512 kb | 12111B 1.0 Mb | 12111C 2.0 Mb | | | | 12102B 512 kb | 12103C 512 kb | | |
| 0.5 | 1 | 0 | 0 | 0 | 0 | None | 10 | 1* | 0 | 0 | None | 10 |
| 1.0 | 0 | 1 | 0 | 0 | 0 | None | 10 | 1* | 1 | 0 | 12038A | 9 |
| 1.5 | 0 | 1 | 1 | 0 | 0 | 12038A | 9 | 1* | 2 | 0 | 12038B | 8 |
| 2.0 | 0 | 1 | 0 | 1 | 0 | 12038A | 9 | 1* | 1 | 1 | 12038B | 8 |
| 2.5 | 0 | 1 | 1 | 1 | 0 | 12038B | 8 | 1* | 2 | 1 | 12038C | 7 |
| 3.0 | 0 | 1 | 0 | 2 | 0 | 12038B | 8 | 1* | 1 | 2 | 12038C | 7 |
| 3.5 | 0 | 1 | 1 | 2 | 0 | 12038C | 7 | 1* | 2 | 2 | 12038D | 6 |
| 4.0 | 0 | 1 | 0 | 1 | 1 | 12038B | 8 | 1* | 1 | 3 | 12038D | 6 |
| 5.0 | 0 | 1 | 0 | 2 | 1 | 12038C | 7 | n/s | n/s | n/s | n/s | n/s |
| 6.0 | 0 | 1 | 0 | 1 | 2 | 12038C | 7 | n/s | n/s | n/s | n/s | n/s |
| 7.0 | 0 | 1 | 0 | 2 | 2 | 12038D | 6 | n/s | n/s | n/s | n/s | n/s |
| 8.0 | 0 | 1 | 0 | 1 | 3 | 12038D | 6 | n/s | n/s | n/s | n/s | n/s |

* 12102B 512 kb Parity Memory Controller must be ordered for 2436A Micro 26 Component to replace standard 128 kb Parity Memory Controller, which is deleted by 2436A Option 014; it is included in 2436E and 2486A and is therefore not required for either of those products.

Installation of the 12154A Battery Backup Module reduces the numbers listed below by two.

n/s = not supported

Table 5. HP 1000 Micro 27 Memory Size and Available Card Cage Slots

| MEMORY SIZE | FOR ECC MEMORY | | | | | FOR PARITY MEMORY | | | | | |
|-------------|-----------------------------------|------------------|------------------|-----------------|----------------------------------|-----------------------------------|------------------|------------------|-----------------|----------------------------------|------------------|
| | ORDER 2437A/2487A OPTION 014 AND: | | | | CARD CAGE SLOTS AVAIL. IN 2487A# | ORDER 2437A/2487A OPTION 014 AND: | | | | CARD CAGE SLOTS AVAIL. IN 2487A# | |
| | MEMORY ARRAYS | | | AND ARRAY CONN. | | MEMORY ARRAYS | | | AND ARRAY CONN. | | |
| | 12111A* 512 kb | 12111B 1.0 Mb | 12111C 2.0 Mb | | | 12103A 128 kb | 12103B 256 kb | 12103C 512 kb | | | 12103D 1.0 Mb |
| 256 kb | n/s | n/s | n/s | n/s | n/s | 0 | 1** | 0 | 0 | 12038A** | 8 |
| 512 kb | 1 | 0 | 0 | 12038A** | 8 | 0 | 0 | 1** | 0 | 12038A* | 8 |
| 1.0 Mb | 0 | 1 | 0 | 12038A | 8 | 0 | 0 | 0 | 1 | 12038A | 8 |
| 1.5 Mb | 1 | 1 | 0 | 12038B | 7 | 0 | 0 | 1 | 1 | 12038B | 7 |
| 2.0 Mb | 0 | 0 | 1 | 12038A | 8 | 0 | 0 | 0 | 2 | 12038B | 7 |
| 2.5 Mb | 1 | 0 | 1 | 12038B | 7 | 0 | 0 | 1 | 2 | 12038C | 6 |
| 3.0 Mb | 0 | 1 | 1 | 12038B | 7 | 0 | 0 | 0 | 3 | 12038C | 6 |
| 3.5 Mb | 1 | 1 | 1 | 12038C | 6 | 0 | 0 | 1 | 3 | 12038D | 5 |
| 4.0 Mb | 0 | 0 | 2 | 12038B | 7 | 0 | 0 | 0 | 4 | 12038D | 5 |
| 5.0 Mb | 0 | 1 | 2 | 12038C | 6 | n/s | n/s | n/s | n/s | n/s | n/s |
| 6.0 Mb | 0 | 0 | 3 | 12038C | 6 | n/s | n/s | n/s | n/s | n/s | n/s |
| 7.0 Mb | 0 | 1 | 3 | 12038D | 5 | n/s | n/s | n/s | n/s | n/s | n/s |
| 8.0 Mb | 0 | 0 | 4 | 12038D | 5 | n/s | n/s | n/s | n/s | n/s | n/s |

NOTE A: The Floating Point Processor card and/or each Writable Control Store Card or PROM Control Store card uses one card cage slot that would otherwise be available for memory array cards, reducing maximum ECC memory size by up to 2 Mb, maximum parity memory size by up to 1 Mb.

* 12111A 512 kb ECC Memory Array Card is preferred, but the 12104A 512 kb ECC Memory Array Card is also usable.

** This applies only to the 2437A Micro 27 component; the 2487A Micro 27 SPU cannot be equipped with less than 512 kb and it includes the 12103C 512 kb Parity Memory Array Card.

Installation of the 12154A Battery Backup Module reduces the numbers listed below by two.

n/s = not supported

Table 6. HP 1000 Micro 29 Memory Size and Available Card Cage Slots

| MEMORY SIZE | ORDER 2439A/2489A OPTION 014 AND: | | CARD CAGE SLOTS AVAILABLE IN 2489A# | |
|-------------|-----------------------------------|------------------|-------------------------------------|---------------------|
| | MEMORY ARRAYS | | | AND ARRAY CONNECTOR |
| | 12220A 768 kb | 12221A 3.0 Mb | | |
| 0.75 Mb* | 1 Std | n/s | 12222A Std | 9 |
| 1.50 Mb | 2 | 0 | 12222B | 8 |
| 3.00 Mb | 0 | 1 | 12222A | 9 |
| 3.75 Mb | 1 | 1 | 12222B | 8 |
| 6.00 Mb | 0 | 2 | 12222B | 8 |

* This is the base ECC memory that is deleted by 2439A/2489A Option 014 to make way for ordering memory arrays and a connector that provide more memory.

Installation of the 12154A Battery Backup Module reduces the numbers listed below by two.

Interfaces

The HP 248xA SPU's and 243xA components can use all of the interfaces listed in the A-Series Interfaces Technical Data book (5953-8760 or later version), but the following interfaces will require the 12159A 25 kHz Sine Wave Card:

- 12060BA High-Level Analog Input card
- 12061A Expansion Multiplexer card
- 12062A Analog Output card
- 12063A 16-Input/16-Output Digital I/O card
- 37203L HP-IB Extender card using coaxial cable communication. (The 37203L Option 001 HP-IB Extender card does not require 25 kHz power for fiber optic cable communication).

Peripheral Devices

See the HP 1000 Peripherals Selection Guide.

Additional Documentation Available

- For A600+:** 02156-90003 HP 1000 A600 Computer Engineering and Reference Documentation.
- For A700:** 02137-90005 HP 1000 A700 Computer Engineering and Reference Documentation.
- For A900:** 02139-90003 HP 1000 A900 Computer Engineering and Reference Documentation.

A600+, A700, and A900 Computers



HP 1000 A-Series Computer Systems

product numbers
2156B, 2137A, and 2139A

The HP 2156B, 2137A, and 2139A are identically-packaged A600+, A700, and A900 box computers for OEMs and end users designing their own rack-mounted systems (see the A-Series Computers and Specifications data sheet on page 1 for comparison of A600+, A700, and A900 capabilities.) In a rack-mountable cabinet 26.6 cm (10.5 in) high by 61.2 cm (24 in) deep these computers house the CPU and base memory capacity with space to spare for memory expansion and I/O interfaces, as summarized below. At least one I/O interface and associated terminal or remote computer system is required in addition to the box computer for a usable system.

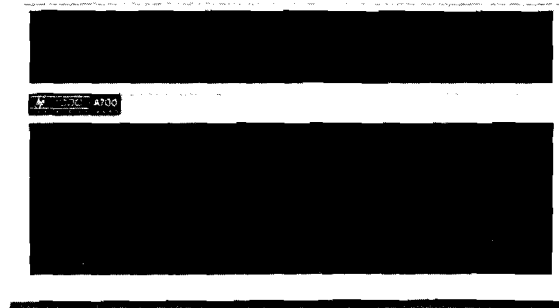
| Computer | 2156B | 2137A | 2139A |
|------------------------|-------|-------|-------|
| Avail. Card Cage Slots | 18 | 16 | 15 |

2156B, 2137A, or 2139A Computer operations can be managed by the 92077A RTE-A Real-Time Executive operating system. The RTE-A system supports multiprogramming, high-level program languages, the 92078A VC+ enhancement for large programs to 7.75 megabytes, virtual memory and extended memory areas for data, data base management, distributed systems networking, graphics software and main memory up to 21 megabytes.

Optionally, the standard main memory can be replaced and/or expanded to 8 megabytes of ECC memory in the 2156B or 2137A Computer, to 21 megabytes of ECC memory in the 2139A Computer.

Many different peripheral devices are available for user-assembled systems, including terminals, discs, printers, graphics devices, and measurement and control subsystems. Peripheral capabilities available with the 2156B, 2137A, and 2139A are well exemplified by the choice of six fixed discs with 24 to 404 megabyte capacity, some with built-in cartridge tape backup. Up to 1.6 gigabytes of disc capacity can be connected via a single interface, using 404 megabyte discs.

The 2156B, 2137A, or 2139A Computer operating in a disc-based RTE-A system supports multi-lingual programming in FORTRAN 77, Pascal, BASIC/1000C, and Macro/1000 assembly languages. Overall, these computers and their available hardware accessories offer users excellent capacity and power for a wide variety of applications.



Features

- Spacious 20-slot card cage with good capacity for memory expansion and I/O interfaces in addition to the CPU and base memory
- Distributed intelligence I/O with DMA per channel I/O efficiency
- Extensive software support, including:
 - Real-time multiprogram executive operating system
 - FORTRAN 77, Pascal, BASIC, and Macroassembler programming plus interactive screen editor, and Symbolic Debug/1000 for program development
 - Image/1000 Data Base Management software
 - Graphics/1000-II software
 - DS/1000-IV Distributed Systems Networking software
 - Three packages for communication with IBM or IBM plug-compatible systems
 - PMC/1000 for process monitoring and control
 - QDM/1000 for quality data management
 - PCIF/1000 for interfacing with programmable controllers
- Large program and data capacity support under 92077A RTE-A operating system with:
 - VC+ capability for programs up to 7.75 megabytes is optional
 - Multiple sharable Extended Memory Areas (EMAs) for data arrays up to 2 megabytes resident in main memory. Up to 15 EMAs are supportable, each sharable by as many as 63 programs

A600+, A700, and A900 Computers

- Virtual memory for data divided between main memory and disc, supports transparent processing of data arrays up to 128 megabytes
- Instruction and program compatibility with other members of the HP 1000 family protects software investment of current OEMs and end users and gives users access to a broad base of proven software
- Built-in dynamic mapping system, memory protect, time base generator, and self test
- Power fail detection and auto restart with optional 12157A Battery Backup System
- Boot loaders support boot-up from:
 - CS/80 disc drive or its integral cartridge tape
 - A magnetic tape unit
 - An adjacent HP 1000 computer system in a DS/1000-IV Distributed Systems Network
 - PROM Storage Module
- Remote loading and diagnosis for programming and operation of systems at remote sites

- Front-to-rear air flow through cabinet maximizes system cooling efficiency and equipment reliability
- High reliability and maintainability through the use of reduced circuit area and simple packaging

Computer description and specifications

For functional description of the Model 2156B, 2137A, and 2139A Computers, memory systems, input/output system, software and diagnostic support, compatibility with other HP 1000 Computers, and A600+, A700, and A900 specifications, see the A-Series Computer Design and Specifications data sheet on page 1.

Computer capacity specifications

Memory Size and Available Card Cage Slots

See Tables 1 through 3.

Table 1. HP 2156B Memory Size and Available Card Cage Slots

| MEM SIZE (Mb) | FOR ECC MEMORY | | | | | | AVAIL. CARD CAGE SLOTS | FOR PARITY MEMORY | | | | | |
|------------------|-----------------------------|------------------|------------------|------------------|------------------|-----------------|------------------------|-----------------------------|------------------|------------------|-----------------|------------------------|------------------|
| | ORDER 2156B OPTION 014 AND: | | | | | | | ORDER 2156B OPTION 014 AND: | | | | | |
| | MEMORY CONTROLLER | | MEMORY ARRAYS | | | AND ARRAY CONN. | | MEMORY CTRLR | MEMORY ARRAYS | | AND ARRAY CONN. | AVAIL. CARD CAGE SLOTS | |
| | 12110A 512 kb | 12110B 1.0 Mb | 12111A 512 kb | 12111B 1.0 Mb | 12111C 2.0 Mb | | | | 12102B 512 kb | 12103C 512 kb | | | 12103D 1.0 Mb |
| 0.5 | 1 | 0 | 0 | 0 | 0 | None | 18 | 1 | 0 | 0 | None | 18 | |
| 1.0 | 0 | 1 | 0 | 0 | 0 | None | 18 | 1 | 1 | 0 | 12038A | 17 | |
| 1.5 | 0 | 1 | 1 | 0 | 0 | 12038A | 17 | 1 | 2 | 0 | 12038B | 16 | |
| 2.0 | 0 | 1 | 0 | 1 | 0 | 12038A | 17 | 1 | 1 | 1 | 12038B | 16 | |
| 2.5 | 0 | 1 | 1 | 1 | 0 | 12038B | 16 | 1 | 2 | 1 | 12038C | 15 | |
| 3.0 | 0 | 1 | 0 | 2 | 0 | 12038B | 16 | 1 | 1 | 2 | 12038C | 15 | |
| 3.5 | 0 | 1 | 1 | 2 | 0 | 12038C | 15 | 1 | 2 | 2 | 12038D | 14 | |
| 4.0 | 0 | 1 | 0 | 1 | 1 | 12038B | 16 | 1 | 1 | 3 | 12038D | 14 | |
| 5.0 | 0 | 1 | 0 | 2 | 1 | 12038C | 15 | n/s | n/s | n/s | n/s | n/s | |
| 6.0 | 0 | 1 | 0 | 1 | 2 | 12038C | 15 | n/s | n/s | n/s | n/s | n/s | |
| 7.0* | 0 | 1 | 0 | 2 | 2 | 12038D | 14 | n/s | n/s | n/s | n/s | n/s | |
| 8.0* | 0 | 1 | 0 | 1 | 3 | 12038D | 14 | n/s | n/s | n/s | n/s | n/s | |

n/s = not supported * = This memory size is not supportable with 12157A Battery Backup.

Table 2. HP 2137A Memory Size and Available Card Cage Slots

| MEMORY SIZE | FOR ECC MEMORY | | | | | AVAIL. CARD CAGE SLOTS | FOR PARITY MEMORY | | | | | |
|-------------|-----------------------------|------------------|------------------|-----------------|------------------------|------------------------|-----------------------------|------------------|------------------|------------------|-----------------|------------------------|
| | ORDER 2137A OPTION 014 AND: | | | | | | ORDER 2137A OPTION 014 AND: | | | | | |
| | MEMORY ARRAYS | | | AND ARRAY CONN. | AVAIL. CARD CAGE SLOTS | | MEMORY ARRAYS | | | | AND ARRAY CONN. | AVAIL. CARD CAGE SLOTS |
| | 12111A* 512 kb | 12111B 1.0 Mb | 12111C 2.0 Mb | | | | 12103A 128 kb | 12103B 256 kb | 12103C 512 kb | 12103D 1.0 Mb | | |
| 256 kb | n/s | n/s | n/s | n/s | n/s | 0 | 1 | 0 | 0 | 12038A | 16 | |
| 512 kb | 1 | 0 | 0 | 12038A | 16 | 0 | 0 | 1 | 0 | 12038A | 16 | |
| 1.0 Mb | 0 | 1 | 0 | 12038A | 16 | 0 | 0 | 0 | 1 | 12038A | 16 | |
| 1.5 Mb | 1 | 1 | 0 | 12038B | 15 | 0 | 0 | 1 | 1 | 12038B | 15 | |
| 2.0 Mb | 0 | 0 | 1 | 12038A | 16 | 0 | 0 | 0 | 2 | 12038B | 15 | |
| 2.5 Mb | 1 | 0 | 1 | 12038B | 15 | 0 | 0 | 1 | 2 | 12038C | 14 | |
| 3.0 Mb | 0 | 1 | 1 | 12038B | 15 | 0 | 0 | 0 | 3 | 12038C | 14 | |
| 3.5 Mb | 1 | 1 | 1 | 12038C | 14 | 0 | 0 | 1 | 3 | 12038D | 13 | |
| 4.0 Mb | 0 | 0 | 2 | 12038B | 15 | 0 | 0 | 0 | 4 | 12038D | 13 | |
| 5.0 Mb | 0 | 1 | 2 | 12038C | 14 | n/s | n/s | n/s | n/s | n/s | n/s | |
| 6.0 Mb | 0 | 0 | 3 | 12038C | 14 | n/s | n/s | n/s | n/s | n/s | n/s | |
| 7.0 Mb | 0 | 1 | 3 | 12038D | 13 | n/s | n/s | n/s | n/s | n/s | n/s | |
| 8.0 Mb | 0 | 0 | 4 | 12038D | 13 | n/s | n/s | n/s | n/s | n/s | n/s | |

* The 12111A 512 kb ECC Memory Array Card is recommended, but the 12104A 512 kb ECC Memory Array Card is also usable.
n/s = not supported

Table 3. HP 2139A Memory Size and Available Card Cage Slots

| MEMORY SIZE | ORDER 2139A OPTION 014 AND: | | | AVAILABLE CARD CAGE SLOTS |
|-------------|-----------------------------|------------------|---------------------|---------------------------|
| | MEMORY ARRAYS | | AND ARRAY CONNECTOR | |
| | 12220A 768 kb | 12221A 3.0 Mb | | |
| 0.75 Mb* | 1 Std | 0 | 12222A Std | 15 |
| 1.50 Mb | 2 | 0 | 12222B | 14 |
| 2.25 Mb | 3 | 0 | 12222C | 13 |
| 3.00 Mb | 0 | 1 | 12222A | 15 |
| 3.75 Mb | 1 | 1 | 12222B | 14 |
| 4.50 Mb | 2 | 1 | 12222C | 13 |
| 5.25 Mb | 3 | 1 | 12222D | 12 |
| 6.00 Mb | 0 | 2 | 12222B | 14 |
| 9.00 Mb | 0 | 3 | 12222C | 13 |
| 12.00 Mb | 0 | 4 | 12222D | 12 |

THE FOLLOWING MEMORY SIZES USE MORE THAN FOUR ARRAY CARDS AND ARE THEREFORE NOT SUPPORTABLE BY THE 12157A BATTERY BACKUP SYSTEM

| | | | | |
|----------|---|---|--------|----|
| 15.00 Mb | 0 | 5 | 12222E | 11 |
| 18.00 Mb | 0 | 6 | 12222F | 10 |
| 21.00 Mb | 0 | 7 | 12222G | 9 |

* This is the base ECC memory that is deleted by 2139A Option 014 to make way for ordering memory arrays and a connector that provide more memory.

Electrical specifications

AC Power Requirements of 2156B, 2137A, and 2139A Computers

Standard line voltage: 115V -25%/ +20% (86-138V).

Option 015 line voltage: 230V -23%/ +20% (178-276V).

Line frequency: 47.5 to 66 Hz.

Maximum power required: 700W.

Power cable: The standard 2156B, 2137A, or 2139A Computer includes a 3 metre (10 ft) power cable with NEMA 5-15P power plug. No power cable is provided with the option 015 version of any of these computers.

DC Current Available and Required for I/O Interfaces and Accessories

The computer power supply provides enough current for any combination of A-Series interfaces or other A-Series plug-ins that can be accommodated in the computer card cage.

Environmental specifications

Temperature and Altitude

| | OPERATING | | NON-OPERATING |
|---|----------------------|----------------------|---------------------------|
| | 3048 10,000 | 4572 15,000 | |
| MAX. ALTITUDE - metres - feet | | | 16400 50,000 |
| TEMPERATURE - degrees C - degrees F | 0 to 55 32 to 131 | 0 to 45 32 to 113 | -40 to +75 -40 to +167 |

Relative Humidity

5% to 95% non-condensing.

Vibration and Shock

HP 2156B, 2137A, and 2139A Computers are type tested for normal shipping and handling shock and vibration (contact factory for review of any application that requires operation under continuous vibration).

Safety and EMI qualification

Safety Qualification

The 2156B, 2137A, and 2139A Computers meet Underwriter's Laboratory (UL), Canadian Standards Association (CSA), and International Electrotechnical Commission (IEC) safety standards.

EMI Qualification

The 2156B, 2137A, and 2139A Computers comply with Federal Communications Commission (FCC) Class A and Verband Deutscher Elektrotechniker (VDE) Level A regulations for Electro Magnetic Interference (EMI) when incorporated in the HP 1000 Model 26 (2196C/D), 27 (2197C/D), and 29 (2199C/D) Computer Systems.

Physical characteristics

Dimensions

26.6 cm (10.5 in) high, 48.3 cm (19 in) wide, 61.2 cm (24 in) deep.

Weight

29.1 kg (64 lb).

Ventilation

Four fans provide 10.7 cubic metres per minute (380 CFM) air flow through the computer card cage from front to rear.

Ordering information

NOTE: The 2156B, 2137A, or 2139A Computer requires the RTE-A operating system and a 12005B terminal interface or 12040B Multiplexer, cable, and a compatible terminal or a DS/1000-IV interface linked to another HP 1000 Computer System for operation.

2156B Computer

The 2156B Computer includes:

- 12102A Memory Controller Card with 128k bytes of parity memory (512 kb or 1 Mb ECC memory is optional, expandable to 8 Mb of ECC memory).
- 12105-60001 A600+ CPU Card, instruction set and VCP ROMs, and 12038A Front plane connector.

3. 20-Slot box with power supply and ventilation.
4. 02156-90002 HP 1000 A600+ Computer Installation and Service Manual.
5. 02156-90001 HP 1000 A600+ Computer Reference Manual.
6. 02103-90005 Computer I/O Interfacing Guide.

2156B Options

- 014:** Deletes 12102A 128 kb parity memory controller, permitting its replacement with another memory controller. (Must order other memory controller, and memory array cards and 12038x connector as appropriate; see Table 1 on page 28.)
- 015:** Operation from 220V ac power. Power options for terminal(s), disc(s), and other peripherals must be ordered separately.

2137A Computer

The 2137A Computer includes:

1. 12103A 128kb Memory array card.
2. 12038A Front plane connector from controller to one memory array card.
3. A700 CPU, including 12152-60001 and 60051 processor cards, 12152-60052 memory controller card, and instruction set and VCP ROMs.
4. 12160A Front Plane Assembly.
5. 20-Slot box with power supply and ventilation.
6. 02137-90002 HP 1000 A700 Computer Installation and Service Manual.
7. 02137-90001 HP 1000 A700 Computer Reference Manual.
8. 02103-90005 Computer I/O Interfacing Guide.

2137A Options

- 001:** Adds 12156A Hardware Floating Point Processor card and Scientific and Vector Instruction Set firmware (including the 12156-90001 A700 Floating Point Processor Installation Manual) and 2k words of available PROM control store mounting space. Also replaces 12160A two-connector Front plane assembly with a 12038B three-connector Front plane assembly (uses one card cage slot).
- 014:** Deletes standard 128k byte memory array card and 12038A front plane connector, permitting its replacement with other memory array cards. (Must order other A700 compatible memory card(s) and appropriate 12038x connector; see Table 2 on page 28.)
- 015:** Operation from 220V ac power. Power options for terminal(s), disc(s), and other peripherals must be ordered separately.

2139A Computer

The 2139A Computer includes:

1. 12201A Sequencer card with ROMs.
2. 12202A Data Path card with Floating Point Processors.
3. 12203A Cache Control card with VCP ROMs.
4. 12204A Memory Controller card.
5. 12220A 768 kb ECC Memory Array card.
6. 12222A Array Connector.
7. 20-slot box with power supply and ventilation.
8. 02139-90002 HP 1000 A900 Computer Installation and Service Manual.
9. 02139-90001 HP 1000 A900 Computer Reference Manual.
10. 02103-90005 Computer I/O Interfacing Guide.

2139A Options

- 014:** Deletes standard 768k byte ECC memory array card and front plane connector, permitting its replacement with other memory array cards. (Must order other A900 compatible memory card(s) and appropriate 12222x array connector; see Table 3 on page 29.)
- 015:** Operation from 220V ac power. Power options for terminal(s), disc(s), and other peripherals must be ordered separately.

Accessories ordering information

Optional Software

See Extensive software support on page 4.

Memory Cards and Array Connectors

See Table 1, 2, or 3 for the memory cards and array connector which are required to provide the desired ECC or parity memory in the 2156B, 2137A, or 2139A Computer.

Plug-in Hardware Accessories

12157A Battery Backup System (provides 15 to 90 minutes of sustaining power for up to four memory array cards), depending upon the system configuration, state of charge, and temperature; additional hold-up time can be achieved by connecting an external battery. NOTE: This accessory is installed in the computer power supply and does NOT use a card cage slot.

12158A 25 kHz Power Module (provides up to 50W of 39V rms ac power (two phases) at 25 kHz, which is filtered from the output of the power supply switcher). NOTE: This accessory is installed in the computer power supply and does NOT use a card cage slot.

User Control Store Cards

12153A A700 Writable Control Store card (provides 4k words of control store space).

12155A A700 PROM Control Store card (provides mounting for up to 8k words of PROMs).

12205A A900 Control Store Board (provides 4k words of writable control store and mounting space for 2k words of 2k control store PROMs).

Interfaces

The HP 2156B, 2137A, and 2139A Computers can use all of the interfaces listed in the A-Series Interfaces Technical Data book (5953-8760 or later version) but the following interfaces will require the 12158A 25 kHz Power Module:

| | |
|--------|---|
| 12060A | High-Level Analog Input Card |
| 12061A | Expansion Multiplexer Card |
| 12062A | Analog Output Card |
| 12063A | 16-Input/16-Output Digital I/O Card |
| 37203L | HP-IB Extender Card using coaxial cable communication. (The 37203L Option 001 HP-IB Extender Card does not require 25 kHz power for fiber optic cable communication.) |

Peripheral Devices

See the HP 1000 Peripherals Selection Guide.

Additional Documentation Available

For 2156B: 02156-90003 HP 1000 A600 Computer Engineering and Reference Documentation

For 2137A: 02137-90005 HP 1000 A700 Computer Engineering and Reference Documentation

For 2139A: 02139-90003 HP 1000 A900 Computer Engineering and Reference Documentation.



HP 1000 A-Series Computer Systems

product numbers
2106BK, 12030A, and 12032A

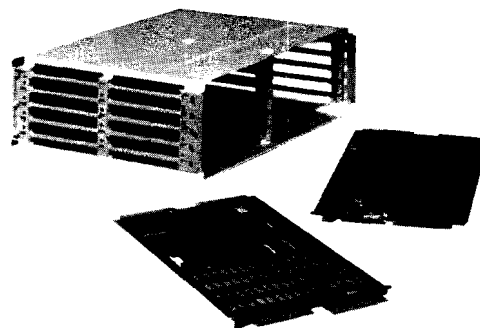
The A600+ Computer is offered as the 2106BK Board Computer for users who choose to design their own systems and packaging. (See the A-Series Computer Design and Specifications data sheet on page 1 for A600+ capabilities.) Optional 5- and 10-slot card cages, product numbers 12032A and 12030A, are offered to facilitate packaging of the 2106BK with I/O interfaces and other optional plug-ins. When appropriately packaged and powered and equipped with suitable peripheral devices, the A600+ Board Computer can use the same software as the 2156B (Box) Computer (see list on page 4).

Features

- Maximum packaging flexibility for OEMs and end users to design their own A-Series computer systems
- Distributed intelligence I/O with DMA per channel I/O efficiency
- Extensive software support under RTE-A
- High reliability and maintainability through the use of reduced circuit area and simple packaging
- Instruction and program compatibility with other members of the HP 1000 family protects software of current OEMs and end users and gives users access to a broad base of proven software
- Built-in dynamic mapping system, memory protect, time base generator, and self test
- Power fail detection and auto restart with optional 12013A Battery Backup Card and RTE-A
- Boot loaders support boot-up from:
 - CS/80 disc drive or its integral cartridge tape
 - A magnetic tape unit
 - An adjacent HP 1000 computer system in a DS/1000-IV Distributed Systems Network
 - PROM Storage Module
- Remote loading and diagnosis for programming and operation of systems at remote sites

Computer description and specifications

For functional description of the 2106BK Board computer, memory system, input/output system, software and diagnostic support, compatibility, and A600+ specifications, see the A-Series Computer Design and Specifications data sheet on page 1.



2106BK Board Computer Specifications

Available Card Cage Capacity

In 12030A Card Cage: Eight slots are available for add-on memory array cards, I/O interfaces, and other plug-in accessories, of which a maximum of three are usable for memory expansion. Because of the front plane connections of the memory and CPU cards, they can be installed in only one 5-slot side of the 12030A 10-Slot Card Cage.

In 12032A Card Cage: Three slots are available for I/O interfaces and other plug-in accessories.

Memory

Memory included in standard 2106BK: 128 kb of parity memory.

Memory supportable by 12013A Battery Backup Card: 128 kb or 512 kb parity memory controller or 512 kb or 1 Mb ECC memory controller. Additional memory array cards cannot be supported.

With 2 Mb ECC memory array cards: HP 2106BK Board Computer option 014 deletes the standard 128 kb parity memory controller to make way for larger memory. With 2106BK Option 014 and a 12110B 1 Mb ECC memory controller, addition of a 12111B 1 Mb ECC memory array card and two 12111C 2 Mb ECC memory array cards expands total memory to 6 megabytes, the maximum that can be accommodated with the CPU and memory controller cards in one side of the 12030A 10-Slot Card Cage.

Electrical specifications

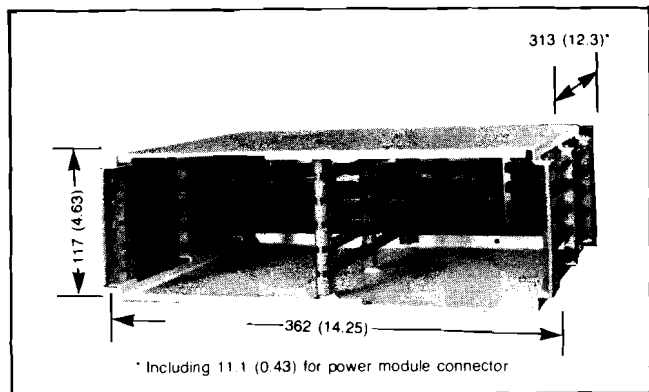
Direct Current Required (-) for 2106BK Board Computer

See Table on page 42.

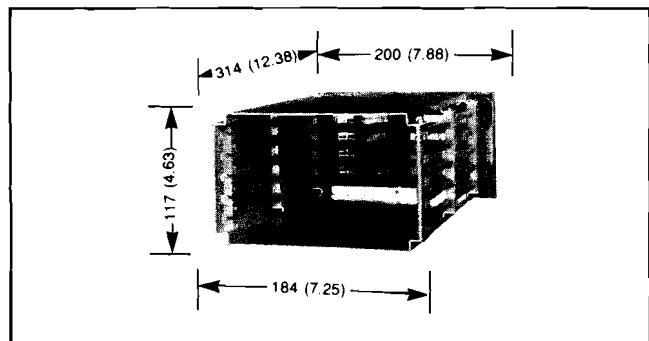
Physical characteristics

Card Cage Dimensions, millimeters (and inches)

12030A 10-Slot Card Cage



12032A 5-Slot Card Cage



Weight

2106BK (two circuit boards): 0.682 kg (1.5 lb).

12030A 10-Slot Card Cage: 2.0 kg (4.4 lb)

12032A 5-Slot Card Cage: 1.09 kg (2.4 lb)

Maximum Heat Dissipation of 2106BK

46 kilogram-calories per hour (184 BTU per hour).

Ventilation

Air flow on the order of 1.13 cubic metres per minute (40 CFM) across the CPU and memory cards is required for cooling the 2106BK Board Computer.

Ordering information

2106BK Board Computer

The 2106BK Board Computer includes:

1. 12102A Memory Controller Card with 128 kb of parity memory.
2. A600+ CPU Card.
3. 12038A Front plane connector.

2106BK Option

014: Deletes 12102A 128 kb parity memory controller to make way for ordering another memory controller, selected from those in Table 1.

Integration Accessories

12030A 10-Slot Card Cage Kit

12032A 5-Slot Card Cage Kit

NOTE: All card cage kits are shipped disassembled to minimize shipping costs and storage space requirements until they are used.

12013A Battery Backup Card

When fully charged, the 12013A Battery Backup Card, which uses Nickel-Cadmium batteries, provides 60 minutes of sustaining power for a 12102A/B 128 kb/512 kb parity memory or a 12110A/B 512 kb/1 Mb ECC memory controller. Additional memory array cards cannot be supported by the 12013A Battery Backup Card.

Memory

See Table 1.

Interfaces

The 2106BK Board Computer is compatible with all of the interfaces listed in the HP 1000 A-Series Interfaces Data book (5953-8760 or later revision) provided that suitable power is available, including 25 kHz ac for certain interfaces.

Additional Documentation for 2106BK:

02156-90003 HP 1000 A600+ Computer Engineering Reference Documentation.

Table 1. HP 2106BK Memory Sizes Supportable in 12030A 10-Slot Card Cage

| MEMORY SIZE | FOR ECC MEMORY | | | | | | FOR PARITY MEMORY | | | | | |
|-------------|------------------------------|------------------|------------------|------------------|-----------------|------------------------|------------------------------|------------------|------------------|------------------|-----------------|------------------------|
| | ORDER 2106BK OPTION 014 AND: | | | | | AVAIL. CARD CAGE SLOTS | ORDER 2106BK OPTION 014 AND: | | | | | AVAIL. CARD CAGE SLOTS |
| | MEMORY CONTROLLER | | MEMORY ARRAYS | | AND ARRAY CONN. | | MEMORY CTRLR. | MEMORY ARRAYS | | | AND ARRAY CONN. | |
| | 12110A 512 kb | 12110B 1.0 Mb | 12111B 1.0 Mb | 12111C 2.0 Mb | | | | 12102B 512 kb | 12103A 128 kb | 12103C 512 kb | | |
| 512 kb | 1 | 0 | 0 | 0 | None | 8 | 1 | 0 | 0 | 0 | None | 8 |
| 1.0 Mb | 0 | 1 | 0 | 0 | None | 18 | 1 | 0 | 1 | 0 | 12038A | 7 |
| 1.5 Mb | n/a | n/a | n/a | n/a | n/a | n/a | 1 | 0 | 2 | 0 | 12038B | 6 |
| 2.0 Mb | 0 | 1 | 1 | 0 | 12038A | 7 | 1 | 0 | 1 | 1 | 12038B | 6 |
| 2.5 Mb | n/a | n/a | n/a | n/a | n/a | n/a | 1 | 0 | 2 | 1 | 12038C | 5 |
| 3.0 Mb | 0 | 1 | 2 | 0 | 12038B | 6 | 1 | 0 | 1 | 2 | 12038C | 5 |
| 4.0 Mb | 0 | 1 | 1 | 1 | 12038B | 6 | n/a | n/a | n/a | n/a | n/a | n/a |
| 5.0 Mb | 0 | 1 | 2 | 1 | 12038C | 5 | n/a | n/a | n/a | n/a | n/a | n/a |
| 6.0 Mb | 0 | 1 | 1 | 2 | 12038C | 5 | n/a | n/a | n/a | n/a | n/a | n/a |



HP 1000 A700 Computer Systems

product numbers
12153A and 12155A

Two control store cards offer comprehensive support for user microprograms in HP 1000 A700 computer systems. One of these is the 12153A 4k word Writable Control Store (WCS) card, which supports development, testing, dynamic overlaying, and output of user's microprograms to the A700 Control Processor. The other card is the 12155A 8k word PROM Control Store (PCS) card, which provides mounting for PROMs containing user's microcode. In addition to hardware support provided by these control store cards, development of user's microprograms and dynamic loading and overlaying of WCS are software supported in a disc-based RTE-A environment by the 92045A Microprogramming Package (see data sheet in the current HP 1000 Software Technical Data book).

Features

- Software subroutines converted to microcode in control store run 3 to 10 times faster than in macro form
- Software support with 92045A Microprogramming Package in disc-based RTE-A operating system
- High-level Paraphraser for writing microcode (included in 92045A)
- Writable Control Store (WCS) support for microcode development, testing, dynamic overlaying, and output, in 4k words of WCS
- Fast loading of WCS overlays at 319k instruction words per second DMA transfer rate using WLOAD utility of 92045A Microprogramming Package
- PROM Control Store (PCS) support for up to 8k words of stable user microcode
- WCS can override installed PROM-based microcode
- Control processor programs sharable among multiple users

NOTE: The 12156A Floating Point Processor counts as one (PROM) control store card and provides 2k words of control store space.

WCS Description

The 12153A WCS card is a dual-port memory. One port connects to the control processor's control store interface and the other to the A700 computer backplane. Control processor instructions can be loaded into the 12153A using DMA transfers from memory at a 319k word/second rate, via the computer backplane. Standard I/O instructions are then used to configure control store module addresses and enable the control processor's control store interface, thereby granting access to the loaded subroutines by the control processor.

PCS Description

The 12155A PCS card provides up to 8k words of non-volatile control memory storage capacity for user-written instruction set enhancements. Module addresses are switch selectable, with a given module configurable to any address within control store address space. Users can supply recommended vendors with necessary information for generating PROM chips that are compatible with the 12155A, or can "burn" their own. The microprograms in PROMs are mounted on the PCS card, which is conveniently installed in the card cage of the A700 computer system.

Functional specifications

Capacity

12153A WCS Card: 4k words, four modules of 1024 words.

12155A PCS Card: Mounting for 8k words, eight modules of 1024 words, four PROMs per module.

Word Size

32 bits.

Microinstruction Cycle Time

250 nanoseconds.

Recommended PROMs for 12155A PCS Card

Signetics 82S181, Harris HM-7681-5, or equivalent 1k x 8 PROM with address access time ≤ 70 nsec, chip enable access time ≤ 40 nsec, and power supply current ≤ 175 mA.

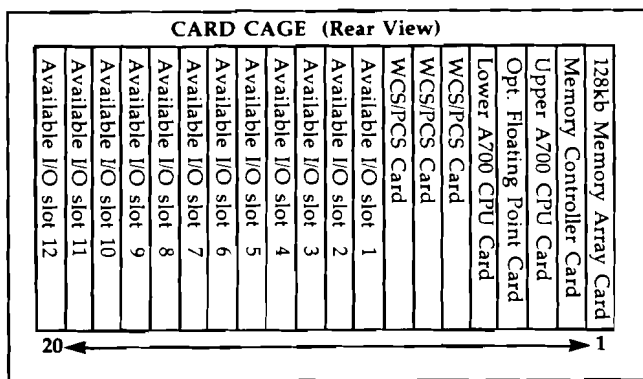
Computer control store card capacity

Up to four WCS/PCS cards (three if the 12156A Floating Point Processor is included in the A700 system, since it counts as a PCS card).

NOTE: Although a maximum of 8k words of control store space is available to the user, two sets each of two 12153A 4k word WCS cards could be used to advantage in some applications as dynamically overlayable control stores for alternate sets of microcode. With two sets of WCS cards, one set can be receiving overlay code from memory while the other is supplying microcode to the control processor. This minimizes time required to change from one set of microcode to the other. Another alternate arrangement might be the use of three 12153A WCS cards and one 12155A PCS card.

Configuration information

Card cage slots required: One for each control store card; control store cards must occupy the card cage slot(s) immediately to the left of the lower A700 CPU card (see the diagram below)



Software recommended: 92045A A700 Microprogramming Package.

Installation: Set the select code switches on the WCS card to the appropriate select code I/O address, or the microaddress range switches on the PCS card to the appropriate microaddresses and plug the card into the I/O slot immediately to the left of the lower A700 CPU card. Disconnect the front plane from the the memory controller and processor cards and connect the flexible jumper cable to the WCS/PCS card(s). Any unused connectors on the jumper cable should be cut off prior to installation.

DC current required for WCS and PCS cards

See table on page 42.

Weight

12153A WCS Card: 0.469 kg (1.03 lb).

12155A PCS Card: 0.384 kg (0.84 lb).

Flexible Cable: 0.085 kg (0.188 lb).

Ordering information

12153A WCS Card

The 12153A WCS Card includes:

1. 12153-60001 WCS card.
2. 1AF5-6001 I/O Processor.
3. 5061-3480 Flexible cable.
4. 02137-90003 User control store installation and service manual.

12155A PCS Card

The 12155A PCS Card includes:

1. 12155-60001 PCS card.
2. 5061-3480 Flexible cable.
3. 02137-90003 User control store installation and service manual.

HP 1000 A900 Computer Systems

product number 12205A

The 12205A Control Store Board offers both writable control store and PROM control store support for user microprograms in HP 1000 A900 computer systems. For development, testing, dynamic overlaying, and output of user's microprograms to the A900 control processor, the control store board provides 4k of writable control store. For stable microcode, the control store board also provides space for mounting 2k words of 2k PROMs containing user's microcode. In addition to the hardware support provided by the 12205A Control Store Board, development of user's microprograms and dynamic loading and overlaying of WCS are software supported in a disc-based RTE-A environment by the 92049A Microprogramming Package (see data sheet in the current HP 1000 Software Technical Data book).

Features

- Software support with 92049A Microprogramming Package in disc-based RTE-A operating system
- Writable Control Store (WCS) support for microcode development, testing, dynamic overlaying, and output, in 4k words of WCS
- Fast loading of WCS overlays at 166k instruction words per second DMA transfer rate using WLOAD utility of 92049A Microprogramming Package
- PROM Control Store (PCS) support for up to 2k words of stable user microcode
- WCS can override installed PROM-based microcode
- Control processor programs sharable among multiple users

WCS Description

The WCS on the 12205A Control Store Board is a dual-port memory. One port connects to the control processor's control store interface and the other to the A900 computer backplane. Control processor instructions can be loaded into the 12205A WCS section using DMA transfers from memory via the computer backplane. Standard I/O instructions are then used to configure control store module addresses and enable the control processor's control store interface, thereby granting access to the loaded sub-routines by the control processor.

PCS Description

The PCS section on the 12205A Control Store Board provides mounting for 2k words of non-volatile control memory storage capacity for user-written instruction set enhancements, when 2k PROMs are used. Control store module addresses are switch selectable, with a given module configurable to any even 2k address block within control store address space. Users can supply recommended vendors with necessary information for generating PROM chips that are compatible with the 12205A, or can "burn" their own. The microprograms in PROMs are mounted on the PROM section of the 12205A board, which is conveniently installed in the card cage of the A900 computer system.

Functional specifications

Environment

The 12205A Control Store Board is usable only in 2139A Computers, 2199C/D Model 29 Computer Systems, and 2439A and 2489A Micro 29 Systems.

Capacity

WCS: 4k words, one module of 4096 words.

PCS: Mounting for 2k words, one module of 2048 words, six PROMs per module.

Word Size

48 bits.

Microinstruction Cycle Time

133 nanoseconds.

Recommended PROM for 12205A Control Store Board

AMD 27S291.

Configuration Information

Card cage slots required: The 12205A Control Store Board is installed in card cage slot 1 (maximum of one 12205A Control Store Board per A900 system).

HP 1000 A900
Control Store Board

Software recommended: 92049A A900 RTE
Microprogramming Package.

Installation: Set the select code switches on the card to the appropriate select code I/O address and plug the card into card cage slot 1. Connect the front plane between the control store and the sequencer card.

DC current requirements

See the table on page 42.

Weight

0.45 kg (1 lb).

Ordering information

12205A Control Store Board

The 12205A Control Store Board includes:

1. 12205-60001 Control store board.
2. 1AF5-6001 I/O Processor.
3. 12205-60002 Front plane.
4. 12205-90001 A900 Control store installation and service manual.

Power requirements

| PRODUCT NUMBER AND NAME | MAX. AC POWER (NOTE A) | VOLTAGE LIMITS (V) | | FREQUENCY LIMITS (Hz) | |
|-------------------------|------------------------|--------------------|--------|-----------------------|-------|
| | | 115V | (230V) | 60 Hz | 50 Hz |

HP 1000 SYSTEM PROCESSOR UNIT (SPU) POWER REQUIREMENTS (Excludes requirements of system console terminal and (hard) non-integrated system disc, which are ordered separately).

| | | | | | |
|--|--------|--------|-----------|-------|---------|
| 219xC MODEL 26/27/29 SPU (56-in Cabinet) | 2760W@ | 86-138 | (178-276) | 48-66 | (48-66) |
| 219xD MODEL 26/27/29 SPU (22.5-in Cabinet) | 1380W | 86-138 | (178-276) | 48-66 | (48-66) |
| 248xA MICRO 26/27/29 SPU | 500W | 86-138 | (178-276) | 48-66 | (48-66) |

HP 1000 COMPUTERS POWER REQUIREMENTS

| | | | | | |
|---------------------------------------|------|--------|-----------|-------|---------|
| 2137A/2139A/2156B COMPUTER | 700W | 86-138 | (178-276) | 48-66 | (48-66) |
| 243xA MICRO 26/27/29 SYSTEM COMPONENT | 500W | 86-138 | (178-276) | 48-66 | (48-66) |

HP 1000 PERIPHERALS POWER REQUIREMENTS

| | | | | | |
|--|--------|------------|------------|------------|-------------|
| 13279B 19-INCH COLOR MONITOR | 170W | 90-128 | (180-257) | 54-66 | (45-55) |
| 2392A DISPLAY TERMINAL | 50W | 86-126 | (173-253) | 47-66 | (47-66) |
| 2563A LINE PRINTER | 470W | 90-126* | (198-252)# | 48-66 | (48-66) |
| 2565A/2566A LINE PRINTER | 550W | 90-126* | (198-252)# | 48-66 | (48-66) |
| 2601A DAISYWHEEL PRINTER | 180W | 85-132* | (187-264)# | 49-61 | (49-61) |
| 2627A COLOR GRAPHICS TERMINAL | 250W | 90-126* | (198-252)# | 57-63 | (47.5-52.5) |
| OTHER 262x TERMINAL | 120W+ | 90-126* | (198-252)# | 57-63 | (47.5-52.5) |
| 2671A/G PRINTER/GRAPHICS PRINTER | 50W | 90-126* | (198-252)# | 47-66 | (47-66) |
| 2673A INTELLIGENT GRAPHICS PRINTER | 75W | 90-126* | (198-252)# | 47-66 | (47-66) |
| 2674A INTERNAL PRINTER FOR 45610B TERMINAL | 20W | See 45610B | See 45610B | See 45610B | See 45610B |
| 2686A LASERJET PRINTER | 850W | 104-126 | Not Supp. | 59.4-60.6 | Not Supp. |
| 2687A DESKTOP LASER PAGE PRINTER | 840W | 104-126 | (198-264)# | 59.4-60.6 | (49.5-50.5) |
| 293xA PRINTERS | 210W | 90-126* | (198-252)# | 48-66 | (48-66) |
| 3074A/M DATA LINK ADAPTER | 11W | 87-126 | (173-253) | 48-66 | (48-66) |
| 37214A SYSTEMS MODEM CARD CAGE | 53W | 90-126* | (198-252)# | 48-66 | (48-66) |
| 39301A FIBER OPTIC MULTIPLEXER | 14W | 90-126* | (198-252)# | 48-66 | (48-66) |
| 45610B HP TOUCHSCREEN TERMINAL | 110W | 86-126 | (173-253) | 57-63 | (47.5-52.5) |
| 7470A 2-pen PLOTTER | 25W | 90-126* | (198-252)# | 48-66 | (48-66) |
| 7475A 6-pen PLOTTER | 35W | 90-126* | (198-252)# | 48-66 | (48-66) |
| 7550A 8-pen PLOTTER WITH AUTOMATIC SHEET FEED | 100W | 90-126* | (198-252)# | 48-66 | (48-66) |
| 7580B/7858B/7886B 8-pen DRAFTING PLOTTERS | 182W | 90-126* | (198-252)# | 48-66 | (48-66) |
| 7911P/R 28.1Mb CS/80 FIXED DISC w/CTU backup | 700W | 90-126* | (198-252)# | 54-66 | (48-55) |
| 7912P/R 65.6Mb CS/80 FIXED DISC w/CTU backup | 700W | 90-126* | (198-252)# | 54-66 | (48-55) |
| 7914P/R 132.1Mb CS/80 FIXED DISC w/CTU backup | 700W | 90-126* | (198-252)# | 54-66 | (48-55) |
| 7914ST 132.1Mb CS/80 FIXED DISC & 1600 BPI MTU | 1220W | 90-125* | (198-250)# | 54-66 | (48-55) |
| 7914TD 132.1Mb CS/80 FIXED DISC & 1600 BPI MTU | 1100W | 104-126 | (207-252) | 54-66 | (48-55) |
| 7933H 404Mb CS/80 Fixed DISC | 1400W | 90-132* | (198-264)# | 48-66 | (48-66) |
| 7935H Removable Media 404Mb CS/80 DISC | 1400W | 90-132* | (198-264)# | 48-66 | (48-66) |
| 7941A/7945A 23.8/55.5 Mb FIXED DISC | 65W(T) | 90-132* | (180-264)# | 48-66 | (48-66) |
| 7970B/E 800/1600 bpi MAGNETIC TAPE UNIT | 400W | 104-126 | (207-252) | 48-66 | (48-66) |
| 7971A MAGNETIC TAPE SUBSYSTEM (per drive) | 400W | 104-126 | (207-252) | 48-66 | (48-66) |
| 7974A MAGNETIC TAPE UNIT (per drive) | 520W | 90-125* | (198-250)# | 48-66 | (48-66) |
| 82905B IMPACT PRINTER | 100W | 90-132* | (198-264)# | 48-66 | (48-66) |
| 82906A DOT-MATRIX PRINTER | 70W | 90-132* | (198-264)# | 48-66 | (48-66) |
| 9111A GRAPHICS TABLET | 25W | 90-132* | (198-264) | 48-66 | (48-66) |
| 9121D Dual MICROFLOPPY DISC | 72W | 86-127 | (196-253) | 48-66 | (48-66) |
| 9133XV 14.5Mb MINI WINCHESTER/MICROFLOPPY DISC | 140W | 90-126* | (196-252)# | 48-66 | (48-66) |
| 9144A TAPE CARTRIDGE SUBSYSTEM | 125W | 90-125 | (180-250) | 48-66 | (48-66) |
| 9895A FLEXIBLE DISC MEMORY | 180W | 90-132* | (198-264)# | 58.8-61.2 | (49-51) |

NOTE A: Power Factor (PF) is typically about 0.75, with a range of 0.7 to 0.78. Use of a PF of 0.7 to 0.72 to estimate ac input requirements in Volt-Amps (VA) from Watts (W) is recommended to assure sufficient total input power (VA = W/PF). For estimation of ventilation or air conditioning requirements in BTU per hour, multiply Watts by 3.419. To determine heat dissipation requirements in kilogram-calories per hour, multiply Watts by 0.8598.

* Range shown for 115V here includes user-selectable choice of 100V or 120V input plus the voltage tolerance (there may be a gap between 105V and 108V).

Range shown for 230V here includes user-selectable choice of 220V or 240V input plus the voltage tolerance.

@ Split-phase power is required for this computer system.

+ Option 050 integral printer adds 50W to 262x Terminal power consumption.

T Denotes typical power consumption, not maximum.

Computer power supply and card cage slot availability (+) and requirements (-)

| Product Number and Name | Card Cage Slots | Direct Current at | | | | 25kHz ac Pwr at 39V rms | Total Power Supply |
|---|-----------------|-------------------|--------|--------|--------|-------------------------|--------------------|
| | | +5V | +5V(M) | +12V | -12V | | |
| COMPUTERS AND SYSTEMS | | | | | | | |
| 2106BK (A600+) Board Computer -- CPU & 128kb Mem Cds | -2 | -9.6A | -1.1A | 0A | 0A | 0W | -53.5W |
| 2106BK Option 014: Deletes standard 128 kb parity mem | +1 | +2.8A | +0.9A | nnc | nnc | n/a | +18.5W |
| 2137A (A700) Computer with 128kb memory | +16 | +42.8A | +5.6A | +5.6A | +3.5A | 0W | n/s |
| 2137A Option 001: Hardware Floating Point Processor | -1 | -4.0A | nnc | nnc | nnc | nnc | n/s |
| 2137A Option 014: Deletes std memory array card | +1 | +1.1A | +1.1A | nnc | nnc | nnc | n/s |
| 2139A (A900) Computer with 768kb ECC memory | +15 | +41.8A | +7.0A | +5.5A | +3.5A | 0W | n/s |
| 2139A Option 014: Deletes std ECC memory array card | +1 | +1.0A | +2.0A | nnc | nnc | nnc | n/s |
| 2156B (A600+) Computer with 128kb memory | +18 | +50.4A | +5.9A | +5.6A | +3.5A | 0W | n/s |
| 2156B Option 014: Deletes standard 128 kb parity mem | +1 | +2.8A | +0.9A | nnc | nnc | n/a | n/s |
| 2196C/D (Model 26) System Processor Unit w/512kb mem | +16 | +46.3A | +5.8A | +5.3A | +3.4A | 0W | n/s |
| 2196C/D option 014: Deletes std 512 kb parity memory | +1 | +2.8A | +1.0A | nnc | nnc | n/a | n/s |
| 2196C Option 070: Compatibility w/7914ST/TD disc+MTU | -1 | -2.1A | nnc | -0.1A | nnc | nnc | n/s |
| 2197C/D (Model 27) System Processor Unit w/512kb mem | +13 | +35.1A | +5.5A | +5.3A | +3.4A | 0W | n/s |
| 2197C/D Option 014: Deletes std memory array card | +1 | +1.1A | +1.1A | nnc | nnc | nnc | n/s |
| 2197C Option 070: Compatibility w/7914ST/TD disc+MTU | -1 | -2.1A | nnc | -0.1A | nnc | nnc | n/s |
| 2199C/D (Model 29) System Proc Unit w/768kb ECC mem | +12 | +38.1A | +7.0A | +5.2A | +3.4A | 0W | n/s |
| 2199C/D Option 014: Deletes std ECC memory array card | +1 | +1.0A | +2.0A | nnc | nnc | nnc | n/s |
| 2199C Option 070: Compatibility w/7914ST/TD disc+MTU | -1 | -2.1A | nnc | -0.1A | nnc | nnc | n/s |
| 2436A Micro 26 System Component with 128kb memory | +12 | +33.4A* | +5.9A* | +7.0A* | +3.0A* | 0W | +246.5W |
| 2436A Option 014: Deletes standard 128 kb parity mem | +1 | +2.8A | +0.9A | nnc | nnc | n/a | +18.5W |
| 2436A Option 111: Adds fixed & microfloppy discs | -1 | -5.7A | nnc | -2.5A | nnc | nnc | -58.5W |
| 2436E Micro 26 System Component with 512kb memory | +12 | +33.4A* | +5.8A* | +7.0A* | +3.0A* | 0W | +246.0W |
| 2436E Option 014: Deletes standard 512 kb parity mem | +1 | +2.8A | +1.0A | nnc | nnc | n/a | +19.0W |
| 2436E Option 111: Adds fixed & microfloppy discs | -1 | -5.7A | nnc | -2.5A | nnc | nnc | -58.5W |
| 2437A Micro 27 System Component with 128kb memory | +10 | +25.9A* | +5.6A* | +7.0A* | +3.0A* | 0W | +207.5W |
| 2437A Option 001: Hardware Floating Point Processor | -1 | -4.0A | nnc | nnc | nnc | nnc | -20.0W |
| 2437A Option 014: Deletes std memory array card | +1 | +1.1A | +1.1A | nnc | nnc | nnc | +11.0W |
| 2437A Option 111: Adds fixed & microfloppy discs | -1 | -5.7A | nnc | -2.5A | nnc | nnc | -58.5W |
| 2439A Micro 29 System Component with 768kb ECC memory | +9 | +26.8A* | +1.0A* | +7.0A* | +3.0A* | 0W | +189.0W |
| 2439A Option 014: Deletes std ECC memory array card | +1 | +1.0A | +2.0A | nnc | nnc | nnc | +15.0W |
| 2439A Option 111: Adds fixed & microfloppy discs | -1 | -5.7A | nnc | -2.5A | nnc | nnc | -58.5W |
| 2486A Micro 26 System Processor Unit w/512kb memory | +10 | +29.7A* | +5.8A* | +6.7A* | +2.9A* | 0W | +222.7W |
| 2486A Option 014: Deletes standard 512 kb parity mem | +1 | +2.8A | +1.0A | nnc | nnc | n/a | +19.0W |
| 2486A Option 111: Adds fixed & microfloppy discs | nnc | -3.6A | nnc | -2.4A | nnc | nnc | -46.8W |
| 2487A Micro 27 System Processor Unit w/512kb memory | +8 | +22.0A* | +5.6A* | +6.7A* | +2.9A* | 0W | +184.2W |
| 2487A Option 001: Hardware Floating Point Processor | -1 | -4.0A | nnc | nnc | nnc | nnc | -20.0W |
| 2487A Option 014: Deletes std memory array card | +1 | +1.1A | +1.1A | nnc | nnc | nnc | +11.0W |
| 2487A Option 111: Adds fixed & microfloppy discs | nnc | -3.6A | nnc | -2.4A | nnc | nnc | -46.8W |
| 2489A Micro 29 System Processor Unit w/768kb ECC mem | +7 | +23.1A* | +1.0A* | +6.7A* | +2.9A* | 0W | +165.7W |
| 2489A Option 014: Deletes std ECC memory array card | +1 | +1.0A | +2.0A | nnc | nnc | nnc | +15.0W |
| 2489A Option 111: Adds fixed & microfloppy discs | nnc | -3.6A | nnc | -2.4A | nnc | nnc | -46.8W |

A600+ MEMORY CONTROLLERS AND A600+ AND A700 MEMORY ARRAY CARDS

| | | | | | | | |
|---|----|-------|---------|----|----|----|--------|
| 12102B 512 kb Parity Memory Controller (A600+) | -1 | -2.8A | -1.0A | 0A | 0A | 0W | -19.0W |
| 12110A 512 kb ECC Memory Controller (A600+) | -1 | -2.9A | -1.1A | 0A | 0A | 0W | -20.0W |
| 12110B 1.0 Mb ECC Memory Controller (A600+) | -1 | -2.9A | -1.2A | 0A | 0A | 0W | -21.0W |
| 12103A 128 kb Parity Mem Array Cd (A600+/A700 addr) | -1 | -1.1A | -1.0A | 0A | 0A | 0W | -10.5W |
| 12103B 256 kb Parity Mem Array Cd (A700 only, addr) | -1 | -1.1A | -1.0A | 0A | 0A | 0W | -10.5W |
| 12103A/B 128/256 kb Mem Array Cd (A700 unaddressed)# | -1 | -1.1A | -0.5A# | 0A | 0A | 0W | -2.5W |
| 12103C 512 kb Parity Mem Array Cd (A600+/A700, addr) | -1 | -1.1A | -1.0A | 0A | 0A | 0W | -11.0W |
| 12103C 512 kb Memory Array Card (A700 unaddressed)# | -1 | -1.1A | -0.6A# | 0A | 0A | 0W | -3.0W |
| 12103D 1 Mb Parity Mem Array Card (A600+/A700 addr) | -1 | -1.3A | -1.6A | 0A | 0A | 0W | -14.5W |
| 12103D 1 Mb Memory Array Cd (A700 only, unaddressed)# | -1 | -1.3A | -1.0A# | 0A | 0A | 0W | -5.0W |
| 12104A 512 kb ECC Memory Array Cd (A700 only, addr) | -1 | -1.5A | -1.4A | 0A | 0A | 0W | -14.5W |
| 12104A 512 kb ECC Mem Array Card (A700 only, unaddr)# | -1 | -1.5A | -0.7A# | 0A | 0A | 0W | -3.5W |
| 12111A 512 kb ECC Mem Array Card (A600+/A700 addr) | -1 | -1.6A | -0.93A | 0A | 0A | 0W | -12.7W |
| 12111A 512 kb ECC Mem Array Cd (A700 unaddressed)# | -1 | -1.6A | -0.3A# | 0A | 0A | 0W | -9.5W |
| 12111B 1 Mb ECC Mem Array Cd (A600+/A700 addressed) | -1 | -1.6A | -1.0A | 0A | 0A | 0W | -13.0W |
| 12111B 1 Mb ECC Mem Array Cd (A700 unaddressed)# | -1 | -1.6A | -0.37A# | 0A | 0A | 0W | -9.9W |
| 12111C 2 Mb ECC Mem Array Cd (A600+ addressed) | -1 | -1.6A | -1.6A | 0A | 0A | 0W | -16.0W |
| 12111C 2 Mb ECC Mem Array Cd (A700 addressed) | -1 | -1.6A | -1.2A | 0A | 0A | 0W | -14.0W |
| 12111C 2 Mb ECC Mem Array Cd (A700 unaddressed)# | -1 | -1.6A | -0.65A# | 0A | 0A | 0W | -11.3W |

FOOTNOTES: n/s = not specified; nnc = no net change; n/a = not applicable

* Total power output from the 243xA/248xA power supply cannot exceed 300W, maximum; use total power supply wattage figures in the last column of the table to confirm that total power output is not exceeded.

In A700 systems and computers, unaddressed memory cards draw only standby current from the +5V(M) supply.

Computer power supply and card cage slot availability (+) and requirements (-), continued

| Product Number and Name | Card Cage Slots | Direct Current at | | | | 25kHz ac Pwr at 39V rms | Total Power Supply |
|--|-----------------|-------------------|--------|-------|--------|-------------------------|--------------------|
| | | +5V | +5V(M) | +12V | -12V | | |
| A900 MEMORY ARRAY CARDS | | | | | | | |
| 12220A Addressed 768kb ECC Mem Array Card (A900 only) | -1 | -1.0A | -2.0A | 0A | 0A | 0W | -15.0W |
| 12220A Unaddr 768kb ECC Mem Array Card (A900 only) | -1 | 0A | -1.0A | 0A | 0A | 0W | -5.0W |
| 12221A 3Mb ECC Mem Array Card (A900 only) | -1 | -1.1A | -2.1A | 0A | 0A | 0W | -16.0W |
| INTERFACES | | | | | | | |
| 12005A/B Asynchronous Serial Interface | -1 | -1.6A | 0A | -0.2A | -0.1A | 0W | -11.6W |
| 12006A Parallel Interface | -1 | -1.9A | 0A | -0.2A | 0A | 0W | -11.9W |
| 12007B HDLC Modem Interface to HP 1000 | -1 | -2.6A | 0A | -0.4A | -0.2A | 0W | -20.2W |
| 12009A HP-IB Interface | -1 | -2.1A | 0A | -0.1A | 0A | 0W | -11.7W |
| 12040B/12041A 8-Channel Asynchronous Multiplexer | -1 | -2.5A | 0A | -0.1A | -0.1A | 0W | -14.9W |
| 12042B/12043A Programmable Serial Interface | -1 | -2.6A | 0A | -0.4A | -0.2A | 0W | -20.2W |
| 12044A HDLC Direct Connect Interface to HP 1000 | -1 | -2.4A | 0A | -0.3A | -0.1A | 0W | -16.8W |
| 12060A/B High-Level Analog Input Card (8 inputs)** | -1 | -1.1A | 0A | 0A | 0A | -7.3W* | -12.8W |
| 12061A Expansion Multiplexer Card (adds 32 inputs to 12060A/B)** | -1 | -0.1A | 0A | 0A | 0A | -2.0W* | -2.5W |
| 12062A Analog Output Card (4 isolated outputs)** | -1 | -1.2A | 0A | 0A | 0A | -7.6W* | -13.6W |
| 12063A 16-In/16-Out Isolated Digital I/O Card** | -1 | -1.0A | 0A | 0A | 0A | -11.4W* | -16.4W |
| 12065A Color Video Monitor Interface | -1 | -3.7A | 0A | -0.5A | -0.02A | 0W | -24.0W |
| 12072A DS/1000-IV Data Link Slave I/F to HP 1000 | -1 | -1.5A | 0A | -0.2A | -0.1A | 0W | -11.1W |
| 12073A Bisync Modem Interface to HP 3000 | -1 | -2.6A | 0A | -0.4A | -0.2A | 0W | -20.2W |
| 12075A DSN/X.25 (LAP-B) Network Interface | -1 | -2.6A | 0A | -0.4A | -0.2A | 0W | -20.2W |
| 12082A Bisync Direct Connect Interface to HP 3000 | -1 | -2.4A | 0A | -0.3A | -0.1A | 0W | -16.8W |
| 12092A A-Series Multipoint/Data Link Interface | -1 | -2.6A | 0A | -0.4A | -0.2A | 0W | -20.2W |
| 37203L HP-IB Extender Card (coaxial cable trans)** | -1 | -0.8A | 0A | 0A | 0A | -0.8W | -4.8W |
| 37203L+001 HP-IB Extender Card using fiber optic cable communication | -1 | -0.8A | 0A | 0A | 0A | 0W | -4.0W |
| 37222A Integral Modem Card | -1 | -1.2A | 0A | -0.1A | -0.1A | 0W | -8.4W |
| OTHER PLUG-IN ACCESSORIES | | | | | | | |
| 12008A PROM Storage Module | -1 | -2.0A | 0A | -0.1A | 0A | 0W | -11.2W |
| 12010A Breadboard Interface (NCTE A) | -1 | -0.8A | 0A | -0.1A | 0A | 0W | -5.2W |
| 12011A Extender Card | nnc | 0A | 0A | 0A | 0A | 0W | n/a |
| 12012A Priority Jumper Card | -1 | 0A | 0A | 0A | 0A | 0W | n/a |
| 12013A Battery Backup Card for 2106BK | -1 | 0A | 0A | -0.1A | 0A | 0W | n/s |
| 12153A A700 Writable Control Store Card | -1 | -4.1A | 0A | -0.1A | 0A | 0W | -21.7W |
| 12154A Battery Backup Card for 243xA/248xA Micro 1000 Systems | -2 | 0A | nnc | nnc | nnc | nnc | -8.0W |
| 12155A A700 PROM Control Store Card (fully loaded) | -1 | -6.3A | 0A | 0A | 0A | 0W | -31.5W |
| 12156A A700 Hardware Floating Point Processor Card | -1 | -4.0A | 0A | 0A | 0A | 0W | -20.0W |
| 12157A Battery Backup System for 219xC/D, 2137/9A, or 2156B | 0 | 0A | 0A | 0A | 0A | 0W | n/s |
| 12158A 25kHz Pwr Mod for 219xC/D, 2137/9A, or 2156B | 0 | 0A | 0A | 0A | 0A | +50W | n/s |
| 12159A 25kHz Sine Wave Card for 243xA/248xA | 0 | 0A | 0A | 0A | 0A | +30W | -6.0W |
| CARD CAGES FOR INTEGRATION OF 2106BK BOARD COMPUTER | | | | | | | |
| 12030A Ten-Slot Card Cage | +10 | n/a | n/a | n/a | n/a | n/a | n/a |
| 12031A Sixteen-Slot Card Cage | +16 | n/a | n/a | n/a | n/a | n/a | n/a |
| 12032A Five-Slot Card Cage | +5 | n/a | n/a | n/a | n/a | n/a | n/a |

FOOTNOTES: n/s = not specified; nnc = no net change; n/a = not applicable

* Total power output from the 243xA/248xA power supply cannot exceed 300W, maximum; use total power supply wattage figures in the last column of the table to confirm that total power output is not exceeded.

** This card requires 25kHz power, which precludes its use in the 2122A/B, 2136C/D, 2142A/B, or 2186C/D Microsystem and requires addition of the 12158A 25kHz power module in the 2137A, 2139A, 2156B, 219xC/D or the 12159A Sine Wave Card in the 243xA or 248xA.

NOTE A: The requirements given here for the 12010A Breadboard Interface do not include power for user-added circuits.

Physical characteristics

| PRODUCT NUMBER AND NAME | DIMENSIONS (HEIGHT x WIDTH x DEPTH) Centimeters and (inches) | APPROXIMATE FLOOR SPACE RECOMMENDED metres and (feet) | NET WEIGHT kg and (lb) |
|-------------------------|--|---|---------------------------|
|-------------------------|--|---|---------------------------|

SYSTEM PROCESSOR UNITS PHYSICAL CHARACTERISTICS [Excludes terminal and (hard) non-integrated system disc]

| | | | |
|--|---------------------------------|-------------------|---------------|
| 219x C MODEL 26/27/29 SYSTEM PROCESSOR UNIT | 161.3x69.9x81.3 (63.4x27.5x32) | 3 x 3 (9 x 9) | 139.5 (307.5) |
| 219x D MODEL 26/27/29 SYSTEM PROCESSOR UNIT | 72x69.9x81.3 (28.3x27.5x32) | 3 x 3 (9 x 9) | 94 (207.5) |
| 248x A MICRO 26/27/29 SYSTEM PROCESSOR UNIT | 17.8x48.3x64.8 (7x19x25.5) | Rack or table mtg | 18.1 (40) |
| 248x A MICRO 26/27/29 SPU in 40025A VERTICAL FLOOR MOUNT | 67.3x34.7x64.8 (26.5x13.6x25.5) | 0.5 x 1 (1.5 x 3) | 23.8 (52.5) |
| 248x A OPTION 111 INTEGRAL DISCS | No change | No change | +2.3 (5) |

COMPUTERS PHYSICAL CHARACTERISTICS

| | | | |
|--|---------------------------------|-------------------|-------------|
| 2137A/2139A/2156B COMPUTER | 26.6x48.3x61.2 (10.5x19x2) | Rack mounting | 29.1 (64) |
| 243x A MICRO 26/27/29 SYSTEM COMPONENT | 17.8x48.3x64.8 (7x19x25.5) | Rack or table mtg | 18.1 (40) |
| 243x A MICRO 26/27/29 COMPONENT IN 40025A VERTICAL FLOOR MOUNT | 67.3x34.7x64.8 (26.5x13.6x25.5) | 0.5 x 1 (1.5 x 3) | 23.8 (52.5) |
| 243x A OPTION 111 INTEGRAL DISCS | No change | No change | +2.3 (5) |

PERIPHERALS PHYSICAL CHARACTERISTICS

| | | | |
|--|-----------------------------------|---------------------|-------------|
| 13279B COLOR MONITOR | 39.9x48.2x59.8 (15.7x19x23.6) | Table mounting | 36.7 (81.0) |
| 2392A DISPLAY TERMINAL | 31.7x45.5x58.2 (12.5x17.9x22.9) | Table mounting | 13 (28.7) |
| 2563A LINE PRINTER | 27.4x23.6x45 (10.8x9.3x17.8) | 1 x 3 (3 x 9) | 34# (75#) |
| 2565A/2566A LINE PRINTER | 110x98.3x63.5 (43.3x38.7x25) | 1 x 3 (3 x 9) | 204 (450) |
| 2601A DAISYWHEEL PRINTER | 25.3x61x48.1 (10x24x19) | Table mounting | 34 (75) |
| 262x TERMINALS | 44x38x66.5 (17.3x15x26) | Table mounting | 22.3 (49) |
| 2671A/G PRINTER/GRAPHICS PRINTER | 10.5x42.8x42.4 (4.1x16.9x16.7) | Table mounting | 12.7 (28) |
| 2673A INTELLIGENT GRAPHICS PRINTER | 10.5x42.8x42.4 (4.1x16.9x16.7) | Table mounting | 14.1 (31) |
| 2674A INTEGRAL PRINTER FOR 45610B | See 45610B | See 45610B | 2.9 (6.4) |
| 2686A LASERJET PRINTER | 29.3x47.5x72.3 (11.4x18.5x28.2) | Table mounting | 32 (71) |
| 2687A DESKTOP LASER PRINTER | 28x51x50 (11x20x19.5) | Table mounting | 62.7 (138) |
| Controller included with 2687A | 28x15x50 (11x6x19.5) | Table mounting | 5.5 (12) |
| 293x A PRINTERS | 18.5x60x36.5 (7.3x23.9x14.4) | 1 x 3 (3 x 9) | 20.4# (45#) |
| 3074A/M DATA LINK ADAPTER | 5x25x11 (2x9.9x4.4) | Table mounting | 1 (2.2) |
| 37214A SYSTEMS MODEM CARD CAGE | 17.8x43.8x33 (7x17.3x13) | Rack mounting | 7.5 (16.5) |
| 39301A FIBER OPTIC MULTIPLEXER | 7.2x42.5x8.9 (2.9x16.8x3.5) | Table mounting | 7.5 (16.5) |
| 45610B HP TOUCHSCREEN TERMINAL | 28.7x45.6x53 (11.3x18x20.9) | Table mounting | 12.2 (27) |
| 7470A (2-pen) PLOTTER | 12.7x43.2x34.3 (5x17x13.5) | Table mounting | 6 (13.5) |
| 7475A (6-pen) PLOTTER | 12.7x56.8x36.7 (5x22.4x14.5) | Table mounting | 7 (16.0) |
| 7550A (8-pen) PLOTTER with Auto Sheet Feed | 21.5x67x89.6 (8.5x26.4x35.3) | Table mounting | 17.3 (38.0) |
| 7580B DRAFTING PLOTTER | 118.8x108.7x55.7 (46.8x42.8x21.9) | 2 x 2 (6 x 6) | 63.6 (140) |
| 7585B DRAFTING PLOTTER | 118.8x139.2x55.7 (46.8x54.8x21.9) | 2 x 2 (6 x 6) | 70.4 (155) |
| 7586B DRAFTING PLOTTER | 118.8x139.2x55.7 (46.8x54.8x21.9) | 2 x 2 (6 x 6) | 86.4 (190) |
| 7911/12/14P FIXED DISC | 72x35.4x74 (28.4x14x29.1) | 1 x 2 (3 x 6) | 85.4 (188) |
| 7911/12/14R FIXED DISC | 31.1x48.3x70.5 (12.25x19x27.8) | Rack mounting | 67.3 (148) |
| 7914ST FIXED DISC AND 1600 bpi MAG TAPE UNIT | 160.0x60.0x80.0 (63.0x23.6x31.5) | 3 x 3 (9 x 9) | 261 (574) |
| 7914TD FIXED DISC AND 1600 bpi MAG TAPE UNIT | 161.3x63.5x81.3 (63.4x25x32) | 3 x 3 (9 x 9) | 272.2 (600) |
| 7933H/7935H 404Mb FIXED/REMOVABLE MEDIA DISC | 82.5x55.2x83.4 (32.5x21.7x32.8) | 1 x 3 (3 x 9) | 154 (339.5) |
| 7941A/7945A 28.3/55.5 Mb FIXED DISC | 13x32.5x28.5 (5.1x12.8x11.2) | Table or rack* mtg | 9.9 (21.8) |
| 7970B/E MAGNETIC TAPE DRIVE | 66.7x48.3x30.4 (26.3x19x12) | Rack mounting | 68.2 (150) |
| 7971A MAGNETIC TAPE SUBSYSTEM WITH ONE DRIVE | 158.5x62.3x90.5 (62.4x24.5x35.6) | 3 x 3 (9 x 9) | 195 (430) |
| ADDITIONAL DRIVE IN 7971A CABINET | No change | No change | 59 (130) |
| 7974A MAGNETIC TAPE SUBSYSTEM WITH ONE DRIVE | 160x60x77.5 (63x23.6x30.5) | 3 x 3 (9 x 9) | 181.8 (400) |
| ADDITIONAL DRIVE IN 7974A CABINET | No change | No change | 54.6 (120) |
| 82905B IMPACT PRINTER | 10.7x37.4x30.5 (4.2x14.7x12) | Table mounting | 5.5 (12.1) |
| 82906A DOT-MATRIX PRINTER | 10x42x34.7 (3.9x16.5x13.7) | Table mounting | 7.5 (16.5) |
| 9111A GRAPHICS TABLET | 8.5x44x44 (3.4x17.3x17.3) | Table mounting | 5.8 (12.8) |
| 9121D DUAL MICROFLOPPY DISC MEMORY | 7.6x32.5x28.5 (3x12.8x11.2) | Table mounting | 4.5 (10) |
| 9133XV WINCHESTER DISC W/ONE MICROFLOPPY | 12.5x32.5x28.5 (5x12.8x11.4) | Table mounting | 9.9 (22) |
| 9144A TAPE CARTRIDGE SUBSYSTEM | 12.5x32.5x28.5 (5x12.8x11.2) | Table or rack* mtg | 8.6 (19) |
| 9895A FLEXIBLE DISC MEMORY | 19.2x48.3x57.5 (7.6x19x22.6) | Table/rack mounting | 26.8 (59) |

* Not including optional stand; without stand, printer is table mounting.

* For rack mounting, the 794x A Disc or 9144A Cartridge Tape Subsystem requires a 19500A Rack Mounting Kit.

Environmental specifications

| PRODUCT NUMBER AND NAME | AMBIENT TEMPERATURE (DEGREES C (DEGREES F)) | | RELATIVE HUMIDITY (NON CONDENSING) | MAXIMUM ALTITUDE, METRES (FEET) | |
|--|--|------------------|---------------------------------------|---------------------------------|----------------|
| | OPERATING | NON-OPERATING | | OPERATING | NON-OPERATING |
| SYSTEM PROCESSOR UNITS (SPUs) ENVIRONMENTAL SPECIFICATIONS (Excludes terminal and (hard) non-integrated system disc) | | | | | |
| 219xC/D MODEL 26/27/29 SPU | 0-40 (32-104) | -40-75 (-40-167) | 5% - 95% | 4572 (15,000) | 15240 (50,000) |
| 248xA MICRO 26/27/29 SPU | 0-40 (32-104) | -40-75 (-40-167) | 5% - 95% | 4572 (15,000) | 15240 (50,000) |
| COMPUTERS ENVIRONMENTAL SPECIFICATIONS | | | | | |
| 2137A/2139A/2156B COMPUTER | 0-40 (32-104) | -40-75 (-40-167) | 5% - 95% | 4572 (15,000) | 15240 (50,000) |
| 2137A/2139A/2156B COMPUTER | 0-55 (32-131) | -40-75 (-40-167) | 5% - 95% | 3048 (10,000) | 15240 (50,000) |
| PERIPHERALS ENVIRONMENTAL SPECIFICATIONS | | | | | |
| 13279B COLOR MONITOR | 0-50 (32-122) | Not specified | 10% - 90% | 3048 (10,000) | Not specified |
| 2392A DISPLAY TERMINAL | 0-55 (32-131) | -40-75 (-40-167) | 5% - 95% | 4572 (15,000) | 15240 (50,000) |
| 2563A LINE PRINTER | 10-50 (50-122) | -40-75 (-40-167) | 30% - 80% | 4572 (15,000) | 15240 (50,000) |
| 2565A/2566A LINE PRINTER | 10-40 (50-104) | -40-75 (-40-167) | 30% - 80% | 4572 (15,000) | 15240 (50,000) |
| 2601A DAISYWHEEL PRINTER | 7-41 (45-105) | -29-57 (-20-135) | 10% - 80% | 2438 (8,000) | 7620 (25,000) |
| 262x TERMINALS without printer | 0-55 (32-131) | -40-60 (-40-140) | 5% - 95% | 4572 (15,000) | 15240 (50,000) |
| 262x TERMINALS with printer | 5-40 (41-104) | -40-60 (-40-140) | 5% - 80% | 4572 (15,000) | 15240 (50,000) |
| 2671A/G or 2673A PRINTER | 0-55 (32-131) | -40-75 (-40-167) | 20% - 95% | 4572 (15,000) | 15240 (50,000) |
| THERMAL PAPER for 2671A/G or 2673A | 0-40 (50-104) | -40-40 (-40-104) | 20% - 90% | 4572 (15,000) | 15240 (50,000) |
| 2686A LASERJET PRINTER | 10-32 (50- 91) | 0-35 (32- 95) | 20% - 80% | 2500 (8,200) | 15000 (49,200) |
| 2687A DESKTOP LASER PRINTER | 10-30 (50- 86) | -40-40 (-40-104) | 20% - 90% | 2500 (8,200) | 15000 (49,200) |
| 293xA PRINTERS | 0-55 (32-131) | -40-75 (-40-167) | 10% - 70% | 4572 (15,000) | 15240 (50,000) |
| 3074A/M DATA LINK ADAPTER | 0-55 (32-131) | -40-75 (-40-167) | 5% - 95% | 4572 (15,000) | 7620 (25,000) |
| 37214A SYSTEMS MODEM CARD CAGE | 0-55 (32-131) | -40-75 (-40-167) | 5% - 95% | 4572 (15,000) | 15240 (50,000) |
| 39301A FIBER OPTIC MULTIPLEXER | 0-55 (32-131) | -40-75 (-40-167) | 5% - 95% | 4572 (15,000) | 15240 (50,000) |
| 45610B HP TOUCHSCREEN TERMINAL with or without 2674A printer | 0-55 (32-131) | -40-75 (-40-167) | 5% - 95% | 4572 (15,000) | 15240 (50,000) |
| 7470A/7475A GRAPHICS PLOTTER | 0-55 (32-131) | -10-75 (-40-167) | 5% - 95% | 4572 (15,000) | 15240 (50,000) |
| 7550A GRAPHICS PLOTTER | 0-55 (32-131) | -10-75 (-40-167) | 5% - 95% | 4572 (15,000) | 15240 (50,000) |
| Automatic Sheet Feed with 7550A | 10-40 (50-104) | -10-75 (-40-167) | 20% - 80% | 4572 (15,000) | 15240 (50,000) |
| 7580B/7585B/7586B DRAFTING PLOTTER | 0-40 (32-104) | -40-75 (-40-167) | 5% - 95% | 4572 (15,000) | 15240 (50,000) |
| Roll Feed with 7586B | 10-30 (50- 86) | -40-75 (-40-167) | 30% - 70% | 4572 (15,000) | 15240 (50,000) |
| 7911P/R CS/80 FIXED DISC (Note A) | 10-40 (50-104) | -40-60 (-40-140) | 20% - 80% | 4572 (15,000) | 15240 (50,000) |
| 7912P/R CS/80 FIXED DISC (Note A) | 10-40 (50-104) | -40-60 (-40-140) | 20% - 80% | 4572 (15,000) | 15240 (50,000) |
| 7914P/R CS/80 FIXED DISC (Note A) | 10-40 (50-104) | -40-60 (-40-140) | 20% - 80% | 4572 (15,000) | 15240 (50,000) |
| 7914ST CS/80 FIXED DISC - MAG TAPE SUBSYSTEM (Note A) | 15-32 (59- 90) | -10-60 (14-140) | 20% - 80% | 3000 (9,843) | 15000 (49,213) |
| 7914TD CS/80 FIXED DISC - MAG TAPE SUBSYSTEM (Note A) | 10-40 (50-104) | -40-60 (-40-140) | 20% - 80% | 3048 (10,000) | 3048 (10,000) |
| 7933H CS/80 FIXED DISC (Note B) | 10-40 (50-104) | -40-65 (-40-149) | 8% - 80% | 3000 (9,843) | 15000 (49,213) |
| 7935H REMOVABLE MEDIA DISC (Note B) | 10-32 (50- 90) | -40-65 (-40-149) | 8% - 80% | 3000 (9,843) | 15000 (49,213) |
| 7941A/7945A FIXED DISC (Note A) | 10-40 (50-104) | -40-60 (-40-149) | 8% - 80% | 3000 (9,843) | 12000 (40,000) |
| 7970E/7971A MAG TAPE UNIT (Note B) | 0-55 (32-131) | -40-75 (-40-167) | 20% - 80% | 3000 (9,843) | 15000 (50,000) |
| 7974A MAGNETIC TAPE UNIT (Note B) | 15-32 (59- 90) | -40-75 (-40-167) | 20% - 80% | 3000 (9,834) | 15000 (50,000) |
| 8290xA/B PRINTERS | 5-35 (41-95) | -30-65 (-22-149) | 10% - 80% | 3048 (10,000) | 15240 (50,000) |
| 9111A GRAPHICS TABLET | 0-55 (32-131) | -40-65 (-40-149) | 5% - 90% | 4572 (15,000) | 15240 (50,000) |
| 9121D DUAL MICROFLOPPY DISC MEMORY | 10-45 (50-113) | -40-60 (-40-140) | 20% - 80% | 4572 (15,000) | 15240 (50,000) |
| 9133XV WINCHESTER DISC W/SINGLE MICROFLOPPY DISC (Note A) | 10-40 (40-104) | -40-60 (-40-140) | 20% - 80% | 4572 (15,000) | 15240 (50,000) |
| 9144A TAPE CARTRIDGE SUBSYSTEM | 5-40 (41-104) | -40-75 (-40-167) | 20% - 80% | 4572 (15,000) | 15240 (50,000) |
| TAPE CARTRIDGES FOR 9144A | 5-40 (41-104) | -40-45 (-40-113) | 20% - 80% | 4572 (15,000) | 15240 (50,000) |
| 9895A FLEXIBLE DISC MEMORY | 10-40 (50-104) | -40-60 (-40-140) | 20% - 80% | 4572 (15,000) | 15240 (50,000) |

Note A: The rate of change of temperature must not exceed 10 degrees C (18 degrees F) per hour.

Note B: The rate of change of temperature must not exceed 20 degrees C (36 degrees F) per hour.





Supersedes 5953-8712

For more information call the HP Sales Office listed in the
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